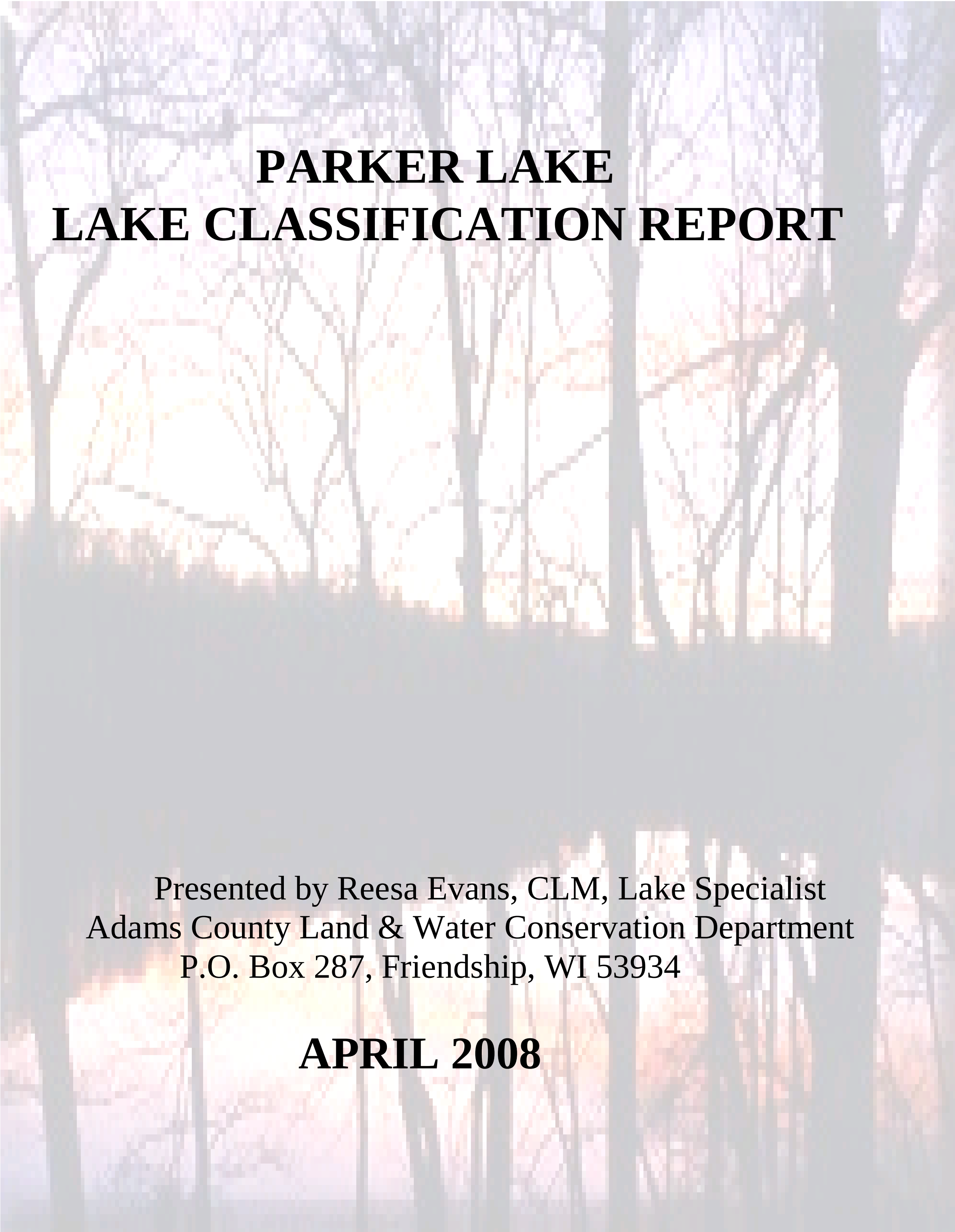
PARKER LAKE
LAKE CLASSIFICATION REPORT



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EXECUTIVE SUMMARY

Background Information Parker Lake

Parker Lake, a natural seepage lake, is located in the Town of Jackson, Adams County in the Central Sands area of Wisconsin. The lake is 60 surface acres in size. Maximum depth is 35', with an average depth of 13'. About 21% of the lake is over 20' deep. Parker Lake is a "seepage" lake, a natural lake fed by precipitation, surface runoff, and groundwater. With no stream outlet, water leaves the lake through groundwater seepage or by evaporation from the lake's surface. The water table in most areas around the lake is near the surface. A proposed lake management plan has been submitted to the WDNR for review & potential approval.

This lake has no natural stream inlet or outlet and fed by precipitation, runoff and groundwater. Parker Lake is part of the Neenah Creek Watershed, a large watershed of 182 square miles which flows into the Fox River and eventually into Lake Michigan. There is no public boat ramp on the lake. There is a wayside on the north side of the lake, owned by the Wisconsin Department of Transportation, which contains a cement path that allows carrying in canoes, kayaks and small boats. There is a private boat ramp on the northeast side of the lake, by Parker Lake Lodge, where anyone can launch a boat for a small fee. There is one reported Native American archeological site in the Parker Lake watersheds, a group of variously-shaped burial mounds. These cannot be further disturbed without permission of the federal government and input from the local tribes.

Except for some pockets of muck, sand and silt loam, the dominant soil in both the surface and ground watersheds for Parker Lake is loamy sand, with slopes from very flat up to 45%.

Loamy sands tend to be well-drained, with water, air and nutrients moving through them at a rapid rate. Runoff, when it occurs, tends to be slow. Loamy sands have little water-holding capacity and low natural fertility, although they usually have more organic matter present than do sandy soils. Both wind and water erosion are potential hazards with loamy sands, as is drought. Getting vegetation started in these soils is often difficult due to the low available water capacity, as well as low natural fertility and organic material. Onsite waste disposal in loamy sand soils is also a problem because of slope and seepage; mound systems are usually required.

Land Use in Parker Lake Watersheds

Both the surface and ground watersheds of Parker Lake are fairly small, as seen in the map and table below. The most common current land uses in the Parker Lake Surface Watershed are non-irrigated agriculture, woodlands and residential, in that order. In the ground watershed, the top two land uses are Woodlands and Residential.

Parker Lake has a total shoreline of 1.16 miles (6125 feet). Most of the shore is in residential properties, including some older cabins that are quite close to the lake shore. Part of the north shore is a wayside owned by the Wisconsin Department of Transportation that includes a cement walkway going down to the lake. On the east shore is a small resort and beach.

The Adams County Land & Water Conservation Department conducted a survey of the Parker Lake shoreline in 2004. Shore types were categorized as "armored" and "vegetated". "Vegetated" shores encompassed both native vegetation of any type and mowed lawns. Native vegetation covers 41.66% of Parker Lake's shoreline. Of the "armored" shores, mowed lawns cover 22.92% and hard structure (piers, etc.) covers 23.37% of the total shore. The remaining 12.15% is bare sand.

The 2004 inventory included classifying areas of the Parker Lake shorelines as having "adequate" or "inadequate" buffers. An "adequate" buffer was defined as one having the first 35 feet landward covered by native vegetation. An "inadequate" buffer was anything that didn't meet the definition of "adequate buffer", including native vegetation strips less than 35 feet landward. Using these definitions, only 31.1% (1995.07 feet) of Parker Lake's shoreline had an "adequate buffer", leaving 67.9% (4219.73 feet) as "inadequate." Most of the "inadequate" buffer areas were found with mowed lawns and/or insufficient native vegetation at the shoreline to cover 35 feet landward from the water line.

Water Testing Results

Between 2004 and 2006, Adams County Land & Water Conservation Department gathered water chemistry and other water quality information on 20 lakes in Adams County with public access. Parker Lake was one of these lakes. Overall, Parker Lake was determined to be a mesotrophic lake with good to very good water quality and water clarity.

Measuring the phosphorus in a lake system provides an indication of the nutrient level in a lake. Increased phosphorus in a lake will feed algal blooms and also may cause excess plant growth. The 2004-2006 summer average phosphorus concentration in Parker Lake was 21.61 micrograms/liter. This is below the 25 micrograms/liter average recommended for natural lakes in Wisconsin to avoid algal blooms. This concentration suggests that Parker Lake is likely to have few nuisance algal blooms.

Water clarity is a critical factor for plants. If plants don't get more than 2% of the surface illumination, they won't survive. Water clarity is measured with a Secchi disk. Average summer Secchi disk clarity in Parker Lake in 2004-2006 was 11.95 feet. This is very good water clarity. Records since 1992 show that the water clarity in Parker Lake has consistently remained high.

Chlorophyll-a concentrations provide a measurement of the amount of algae in a lake's water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth, as well as result in unpleasing odor and appearance. The 2004-2006 summer (June-September) average chlorophyll-a concentration in Parker Lake was 4.4 micrograms/liter, a low algal concentration, further supporting that algal blooms are likely to be uncommon on Parker Lake

Low dissolved oxygen levels during the summer in the bottom waters of a lake occurs naturally as oxygen in the bottom layer is consumed, but not replenished. As the summer progresses, the oxygen concentration of the bottom waters may decrease. In Parker Lake, there were hypoxic (low oxygen) periods in the lower depths during the summers of 2004 and 2005. Besides being a potential danger to a lake's fish population, summer hypoxia can result in phosphorus being released into the upper water column and being available for algal blooms and increased aquatic plant growth. The data collected at Parker Lake from 2004-2006 shows there is a potential for phosphorus loading from the lower depths (hypolimnion) during the summer months in Parker Lake if the hypoxia/anoxia continues. Dissolved oxygen needs to be monitored during the late summer months in the lower depths on Parker Lake to determine whether hypoxia/anoxia is a frequently-occurring condition that may need to be addressed by management practices.

Water testing results for Parker Lake showed "very hard" water (153 mg/l $CaCO_3$). Hard water lakes tend to produce more fish and aquatic plants than soft water lakes because they are often located in watersheds with soils that load phosphorus into the lake water. Hardness levels over 180 mg/l can cause marl to start precipitating out of the water or sediment, thus releasing phosphorus for aquatic plant and algae use. Since Parker Lake's hardness is far below that, the marl in the lake is likely to keep binding a significant amount of phosphorus that would otherwise be in the water column.

A lake with a neutral or slightly alkaline pH like Parker Lake is a good lake for fish and plant survival. Natural rainfall in Wisconsin averages a pH of 5.6. This means that if the rain falls on a lake without sufficient alkalinity to buffer that acid water coming in by rainfall, the lake's fish cannot reproduce. That is not a problem at Parker Lake.

Most water quality testing at Parker showed no particular areas of concern. The average calcium level in Parker Lake's water during the testing period was 25.8 mg/l. The average Magnesium level was 21.73 mg/l. Both of these are low-level readings.

Nitrogen levels can also affect other aspects of water quality. The sum of water testing results for nitrate, nitrite and ammonium levels of over .3 mg/l in the spring can be used to project the likelihood of an algal bloom in the summer (assuming sufficient phosphorus is also present). Parker Lake nitrogen-combination spring levels from 2004 to 2006 never rose to more than .23 mg/l, significantly below the .3 mg/l predictive level.

The potassium level in Parker Lake was very low: average reading of .87 mg/l. To prevent the formation of hydrogen sulfate, a poisonous substance, levels of 10 mg/l of sulfate are best. A health advisory kicks in at 30 mg/l. Parker Lake sulfate levels average 8.87 mg/l during the testing period, far below either level. Turbidity reflects water clarity. The term refers to suspended solids in the water column—solids that may include clay, silt, sand, plankton, waste, sewage and other pollutants. Very turbid waters may not only smell and mask bacteria & other pollutants, but also tend to be aesthetically displeasing, thus curtailing recreational uses of the water. Turbidity levels for Parker Lake's waters were all at very low levels.

The chloride and sodium levels at Parker Lake are potential areas of concern. The presence of a significant amount of chloride over a period of time may indicate that there are negative human impacts on the water quality present. The elevated chloride levels found in Parker Lake during testing period were 23.5 mg/l, far above the recommended level of 3 mg/l. This correlates to the elevated sodium levels on Parker Lake of 11.94 mg/l. These readings suggest there might be problems to be investigated.

<u>Phosphorus</u>

Like most lakes in Wisconsin, Parker Lake is a phosphorus-limited lake: of the pollutants that end up in the lake, the one that most affects the overall quality of the lake water is phosphorus. The amount of phosphorus especially affects the frequency and density of aquatic vegetation and the frequency and density of various kinds of algae, as well as water clarity and other quality aspects.

The total phosphorus (TP) concentration in a lake is considered a good indicator of a lake's nutrient status, since the TP concentration tends to be more stable than other types of phosphorus concentration. For a natural lake like Parker Lake, a total phosphorus concentration below 25 micrograms/liter tends to indicate few nuisance algal blooms are likely to occur. Parker Lake's growing season (June-September) surface average total phosphorus level of 21.61 micrograms/liter is lower than the recommended 25 micrograms/liter. If nuisance algal blooms do occur, they are probably localized.

In most lakes in Wisconsin, phosphorus concentration in the bottom sediments of the lake is considerably higher than the concentration in the water column itself. Bottom sediments can "bind up" phosphorus, making it unavailable for aquatic plants or algae to use. Some sediment types hold phosphorus at a higher rate than others. Parker Lake is lucky to have a substantial amount of marl in its sediments. "Marl" is a calcium carbonate precipitate (solid) that forms in hardwater lakes when both calcium and pH levels are high and has a high capacity to immobilize phosphorus and other nutrients. With such a large amount of marl sediment, Parker Lake may benefit from it removing phosphorus from water column, thus making it unavailable for algal and aquatic plant growth.

Land use plays a major role in phosphorus loading. Some phosphorus deposition cannot be controlled by humans. However, some phosphorus (and other nutrient) input can be decreased or increased by changes in human land use patterns. Practices such as waterbody shoreland buffer restoration; infiltrating stormwater runoff from roof tops, driveways and other impervious surfaces; using no phosphorus lawn fertilizers; and reducing phosphorus input to and properly managing septic systems will minimize phosphorus inputs into the lake.

Reducing the amount of input from the surface and ground watersheds results in less nutrient loading into the lake itself. Under modeling predictions, reducing phosphorus inputs from human-based activities even 10% would improve Parker Lake in-lake water quality by 1.5 to 9 micrograms of phosphorus/liter; a 25% reduction would save 2 to 21 micrograms/liter. Since the summer phosphorus levels is above the threshold value of 20 micrograms/liter to avoid algal blooms, a phosphorus increase from human activities of only 25% would put the phosphorus levels in the lake well over that threshold in the summer. The result would be more algal blooms and more aquatic plants. Decreases would reduce those problems. The modeling predictions make it clear that reducing current phosphorus human-impacted inputs to the lake are essential to improve, maintain and protect Parker Lake's health for future generations.

Aquatic Plant Community

The quality of the aquatic plant community in Parker Lake is about average for Wisconsin lakes and for lakes in the North Central Hardwood region, as measured by the Aquatic Macrophyte Community Index. Structurally, it does contain emergent plants, rooted plants with floating leaves, and submergents. However, the community is characterized by plants that tolerate a high amount of disturbance and common filamentous algae.

The Parker Lake aquatic plant community has colonized 92% of the littoral zone. The most frequent and dominant plant in the lake was actually a plant-like algae, *Chara* spp. Sub-dominant were *Myriophyllum spicatum*, *Najas guadelupensis*, and *Potamogeton illinoensis.* Four species reached a frequency of 50% or greater: *Chara* spp; *Myriophyllum spicatum* (Eurasian watermilfoil, an aggressive invasive), *Potamogeton illinoenisis* (Illinois pondweed), and *Potamogeton pectinatus.*

In Parker Lake, species found in a greater than average density were: *Ceratophyllum demersum*:; *Chara* spp.; *Myriophyllum spicatum; Najas guadelupensis* (Southern naiad); *Nymphaea odorata* (white water lily); and *Potamogeton illinoensis. Potamogeton crispus* and *Phalaris arundinacea*, two of the three exotics found in Parker Lake, were not present in high frequency, high density or high dominance.

The presence of several invasive, exotic species is a significant factor. A visual survey in late May 2006 indicated Curly-Leaf Pondweed was found in much of the lake, although not in amounts of high frequency or density. Reed Canarygrass was only found in the shallowest depth zone. However, both when the August 2005 survey was done and during the 2006 visual survey, large dense patches of Eurasian Watermilfoil (EWM) were evident all over the lake. Its tenacity and ability to spread to large areas fairly quickly make it a danger to the diversity of Parker Lake's current aquatic plant community. The Parker Lake Association controlled the EWM growth in 2007 by chemically treating the largest patches in the lake. Another treatment is planned for 2008. Continued monitoring and management of EWM is necessary to keep it from taking over Parker Lake's aquatic plant community.

Fish/Wildlife/Endangered Resources

There was a chemical kill of fish in 1966 to remove carp from Parker Lake. WDNR stocking records for Parker Lake go back to 1967, when the lake was stocked with walleye, rainbow & brown trout and bluegills. Stocking of these three fish continued until 1981, when it was determined that stocking for walleye and rainbow trout weren't succeeding in establishing a population. After that time, largemouth bass and brown trout were stocked.

Fishing inventories through the years tended to show that bluegill, largemouth bass and pumpkinseed were either abundant or common (depending on the year), with yellow perch, northern pike and bullheads present or scarce.

Muskrat are also known to use Parker Lake shores for cover, reproduction and feeding. Seen during the field survey were various types of waterfowl, songbirds, and turkey. Frogs and salamanders are known, using the lake shores for shelter/cover, nesting and feeding. Turtles and snakes also use this area for cover or shelter in this area, as well as nested and fed in this area.

No endangered resources are reported to occur in the Parker Lake watersheds.

Conclusion

Parker Lake is currently a fairly healthy lake with many positive aspects, as discussed in this report. The main foci of continued management should include shoreland restoration, integrated management of invasive species, reduction of human-impacts on phosphorus loading, reducing the amount of unfiltered stormwater runoff into the lake, well-managed land use and continued monitoring for water quality and invasive species.

It is hoped that the recommendations below will help in these aims.

RECOMMENDATIONS

Lake Management Plan

The Parker Lake Association has submitted a proposed lake management plan to the WDNR for review and possible approval. This plan includes the following aspects of management of the lake (and others): aquatic plant management; control/management of invasive species; wildlife and fishery management; watershed management; shoreland protection; critical habitat protection; water quality protection.

Watershed Recommendations

Although neither the surface nor ground watershed for Parker Lake is particularly large, results of the modeling certainly suggests that input of nutrients, especially phosphorus, are a factor that needs to be explored for Parker Lake.

Therefore, it is recommended that both the surface and ground watersheds be inventoried, documenting any of the following: runoff from any livestock operations that may be entering the surface water; soil erosion sites; agricultural producers not complying with nutrient management plans and/or irrigation water management plans.

If such sites are documented, steps for dealing with these issues can be incorporated into the lake management plan already submitted.

Shoreland Recommendations

1) All lake residents should practice best management on their lake properties, including keeping septic systems cleaned and in proper condition, eliminating the use of lawn fertilizers, cleaning up pet wastes and not composting near the water.
2) Residents should use best management practices to prevent unfiltered highway and stormwater runoff from reaching the lake.

Aquatic Plant/Aquatic Invasive Species

1) Residents should become more involved in the Citizen Lake Water Monitoring Program, Invasive Species Monitoring and Clean Boats, Clean Waters. This will allow not only noting changes in the Eurasian Watermilfoil, Curly-Leaf Pondweed and Reed Canarygrass patterns, but also help identify any new invasive species. Noting the presence and density of these species early is the best way to take preventive action to keep them from becoming a bigger problem.

2) Lake residents should protect and increase natural shoreline in some areas of the lake around Parker Lake. In general, disturbed shoreline sites support an aquatic plant community that is less able to resist invasions of exotic species and shows impacts from nutrient enrichment.

3) All lake users should protect the aquatic plant community in Parker Lake by reducing the removal of native plant species from the lakebed, controlling runoff into the lake that encourages dense plant and algal growth, and either maintaining or installing shoreland buffers.

4) The Parker Lake Association should maintain exotic species signs at lake entry points and contact WDNR if the signs are missing or damaged.

5) The Parker Lake Association should continue monitoring of Eurasian Watermilfoil and hand-pulling. Early-season chemical treatments may be necessary if the spread can’t be stopped. Residents should be encouraged to hand-pull scattered EWM plants. Curly-leaf Pondweed and Reed Canarygrass should also be monitored.

LAKE CLASSIFICATION REPORT
FOR PARKER LAKE, ADAMS COUNTY

INTRODUCTION

In 2003, The Adams County Land & Water Conservation Department (Adams County LWCD) determined that a significant amount of natural resource data needed to be collected on the lakes with public access in order to provide it and the public with information necessary to manage the lakes in a manner that would preserve or improve water quality and keep it appropriate for public use. In some instances, there was significant historical data about a particular lake; in that instance, the study activities concentrated on combining and updating information. In other instances, there was no information on a lake, so study activities concentrating on gathering data about that lake. Further, it was discovered that information was scattered among various citizens, so often what information was actually available regarding a particular lake was unknown. To assist in updating some information and gathering baseline information, plus centralize the data collected, so the public may access it. The Adams County LWCD received a series of grants from the Wisconsin Department of Natural Resources (WDNR) from the Lake Classification Grant Program.

Objectives of the study were:

- collect physical data on the named lakes to assist in assessing the health of Adams County lake ecosystems and in classifying the water quality of the lakes.
- collect chemical and biological data on the named lakes to assist in assessing the health of Adams County lake ecosystems and in classifying the water quality of the lakes.
- develop a library of lake information that is centrally located and accessible to the public and to City, County, State and Federal agencies.
- make specific recommendations for actions and strategies for the protection, preservation and management of the lakes and their watersheds.
- create a baseline for future lake water quality monitoring.
- Provide technical information for the development of comprehensive lake management plans for each lake
- provide a basis for the water quality component of the Adams County Land and Water Resource Management Plan. Components of the plan will be incorporated into Adams County's "Smart Growth Plan".
- develop and implement educational programs and materials to inform and education lake area property owners and lake users in Adams County.

METHODS OF DATA COLLECTION

To collect the physical data, the following methods were used:

- delineation & mapping of ground & surface watersheds using topographic maps, ground truthing and computer modeling;
- identification of flow patterns for both the surface & ground watersheds using known flow maps and topographic maps;
- inventory & mapping of current land use with orthographic photos and collected county information;
- inventory & mapping of shoreline erosion and buffers using county parcel maps and visual observation;
- inventory & mapping for historical and cultural sites using information from the local historical society and the Wisconsin Historical Society;
- identification & mapping of critical habitat areas with WDNR and Adams County LWCD staff;
- identification & mapping of endangered or threatened natural resources (including natural communities, plant & animal species) using information from the Natural Heritage Inventory of Wisconsin;
- identification & mapping of wetland areas using WDNR and Natural Resource Conservation Service wetland maps;
- preparation of soil maps for each of the lake watersheds using soil survey data from the Natural Resource Conservation Service.

To collect water quality information, different methods were used:

- for three years, lakes were sampled during late winter, at spring and fall turnover, and several times during the summer for various parameters of water quality, including dissolved oxygen, relevant to fish survival and total phosphorus, related to aquatic plant and algae growth;
- random samples from wells in each lake watershed were taken in two years and tested for several factors;
- aquatic plant surveys were done on all 20 lakes and reports prepared, including identification of exotics, identifying existing aquatic plant community, evaluation of community measures, mapping of plant distribution, and recommendations;
- all lakes were evaluated for critical habitat areas, with reports and recommendations being made to the respective lakes and the WDNR;
- lake water quality modeling was done using data collected, as well as historical data where it was available.

WATER QUALITY COMPUTER MODELING

Wisconsin developed a computer modeling program called WiLMS (Wisconsin Lake Modeling Suite) to assist in determining the amount of phosphorus being loaded annually into a lake, as well as the probable source of that phosphorus. This suite has many models, including Lake Total Phosphorus Prediction, Lake Eutrophic Analysis Procedure, Expanded Trophic Response, Summary Trophic Response, Internal Load Estimator, Prediction & Uncertainty Analysis, and Water & Nutrient Outflow. The models that various types of data inputs: known water chemistry; surface area of lake; mean depth of lake; volume of lake; land use types & acreage. This information is then used in the various models to determine the hydrologic budget, estimated residence time, flushing rate, and other parameters.

Using the data collected over the course of the studies, various models were run under the WiLMS Suite. These water quality models are computer-based mathematical models that simulate lake water quality and watershed runoff conditions. They are meant to be a tool to assist in predicting changes in water quality when watershed management activities are simulated. For example, a model might estimate how much water quality improvement would occur if watershed sources of phosphorus inputs were reduced. However, it should be understood that these models predict only a relative response, not an exact response. Modeling results will be incorporated into topic discussions as appropriate.

DISSEMINATION OF PROJECT DELIVERABLES

The results of this study will be distributed various agencies, organizations and the public as previously described. Based on the classification information, the Adams County Land and Water Conservation Department will identify assistance requests and determine the appropriate future activities, based on the classification determinations. To provide the requested assistance, Adams County Land and Water Conservation Department will incorporate the lake management plans goals, priorities and action items into its Annual Plan of Operations. Goals, priorities and action items may include educational programs, formation of lake districts, further development of lake management plans and implementation of lake management plans.

ADAMS COUNTY INFORMATION

Adams County lies in south central Wisconsin, shaped roughly like the outline of Illinois. Adams County is a small rural county with a full-time population of about 20,000. Between 1980 and 2000, Adams County's population grew by more than 20%, with most of the population increase being located upon the lakes and streams. The population increase has resulted in a greater need for facilitation, technical assistance and education, including information on the lakes and streams.

Figure 1: Adams County Location in Wisconsin

PARKER LAKE BACKGROUND INFORMATION

Parker Lake is a natural lake of 61.7 surface acres in size. Maximum depth is 30'+, with an average depth of 13'. About 21% of the lake is over 20' deep. Parker Lake is a "seepage" lake, a natural lake fed by precipitation, surface runoff, and groundwater. With no stream outlet, water leaves the lake through groundwater seepage or by evaporation from the lake's surface. The water table in most areas around the lake is near the surface. Parker Lake is one of many lakes in the Town of Jackson, most of which are seepage lakes similar to Parker Lake (see arrow below pointing to location of Parker Lake in the Town of Jackson).

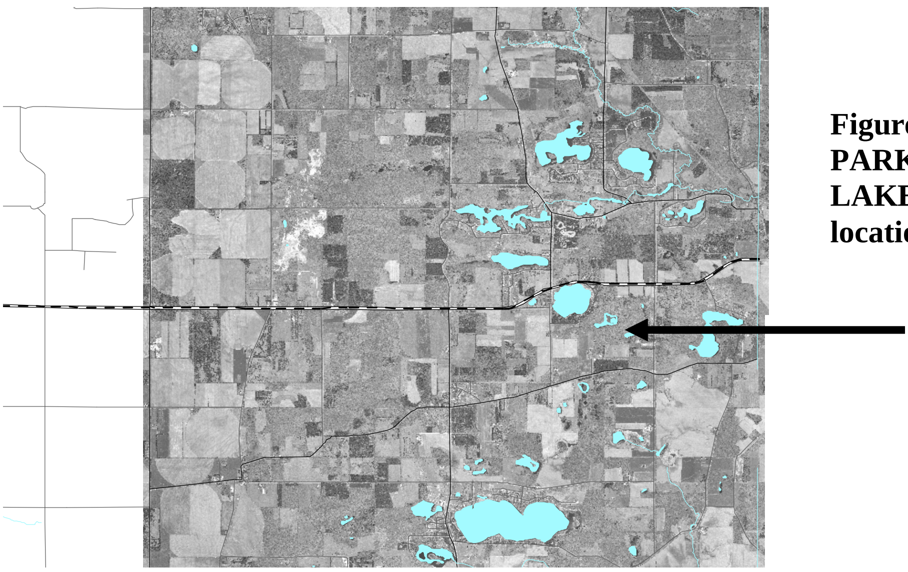

Figure 2: PARKER LAKE location

Parker Lake is part of the Neenah Creek Watershed, a large watershed of 182 square miles which flows into the Fox River and eventually into Lake Michigan. The Central Sand Hills, which contain Parker Lake, are an ecological landscape (a recessional moraine) on the eastern edge of what was Glacial Lake Wisconsin. The area is characterized by glacial moraines and glacial outwash, as well as the kettle holes that formed natural lakes—such as Parker Lake. Elevations average between 900 to 1000 feet above sea level.

Archeological Sites

There are many Native American archeological sites in Adams County, with one near around Parker Lake of a burial mound group. Under the federal act on Native American burials, these sites cannot be further disturbed without permission of the federal government and input from the local tribes.

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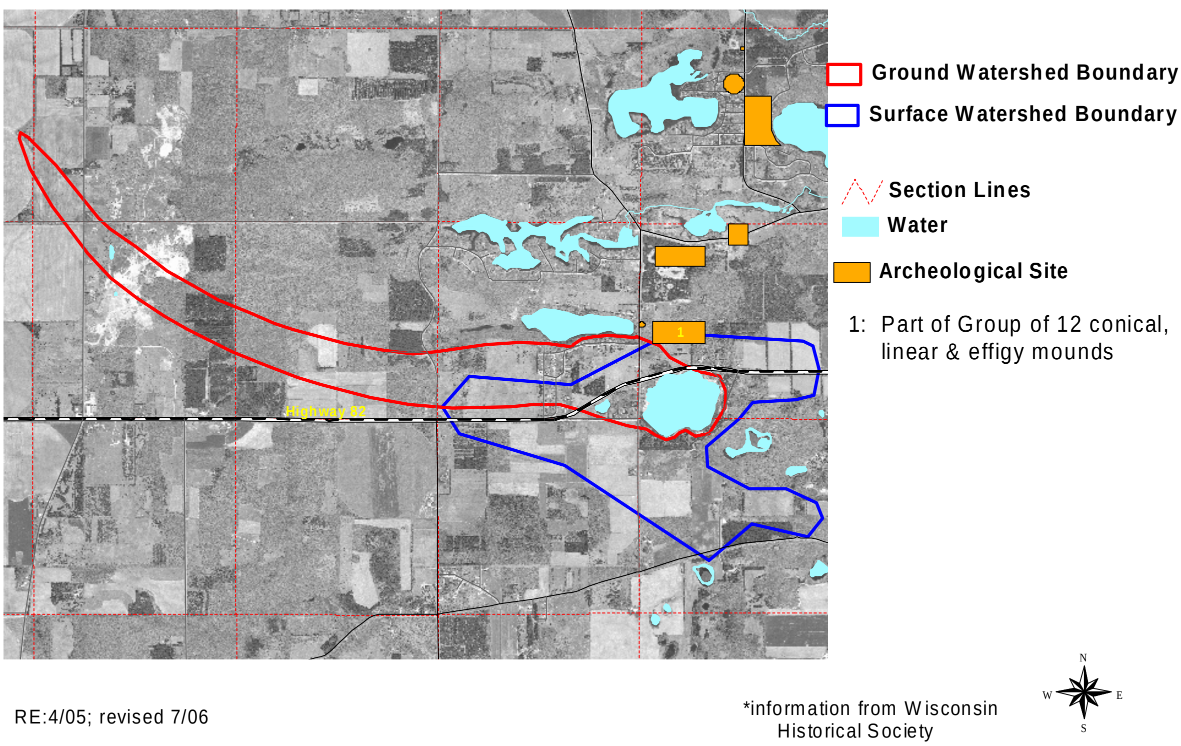
Figure 3: Parker Lake Archeological Sites



Bedrock and Historical Vegetation

Bedrock around Parker Lake is mostly sandstone, with pockets of dolomite and shale, formed in the Cambrian Period of Geology (542 to 488 millions years ago). Bedrock is generally 50’ to 100’ down from the land surface. The water table in most areas around Parker Lake is fairly near the surface.

Original upland vegetation of the area around Parker Lake included oak-forest, oak savanna, pine barrens and tallgrass prairie. Wetland areas were also common, including wet-mesic prairies, wet prairie, coastal plain marshes and fen. Hills and kettles created by glacial deposits make up the southeast area of Adams County, where Parker Lake is located.

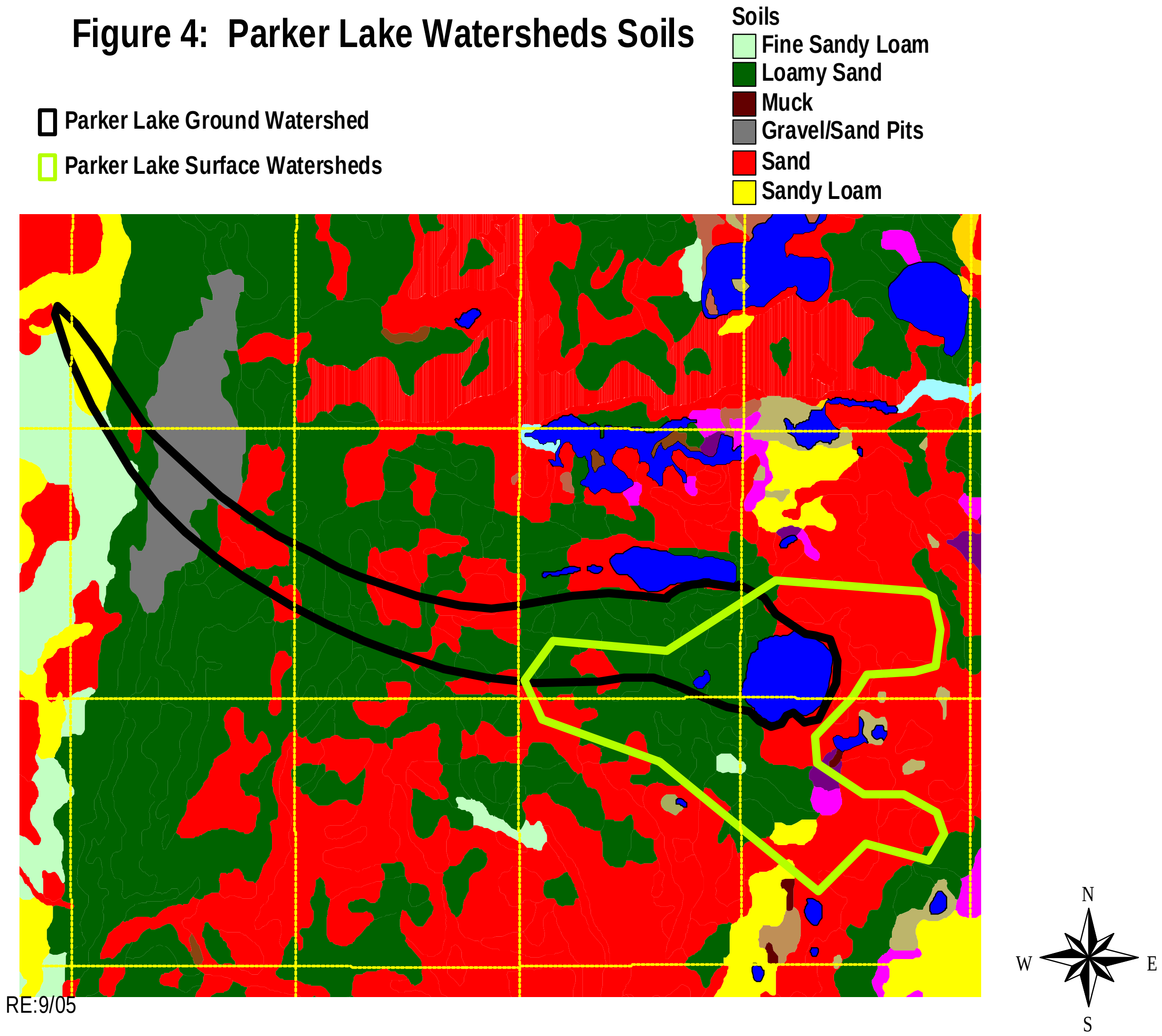
Soils in the Parker Lake Watersheds

Except for some pockets of muck, sand and silt loam, the dominant soil in both the surface and ground watersheds for Parker Lake are loamy sand, with slopes from very flat up to 45%.

Loamy sands tend to be well-drained, with water, air and nutrients moving through them at a rapid rate. Runoff, when it occurs, tends to be slow. Loamy sands have little water-holding capacity and low natural fertility, although they usually have more organic matter present than do sandy soils. Both wind and water erosions are potential hazards with loamy sands, as is drought. Getting vegetation started in these soils is often difficult due to the low available water capacity, as well as low natural fertility and organic material. Onsite waste disposal in loamy sand soils is also a problem because of slope and seepage; mound systems are usually required.

The soil and slopes around lakes and streams are very important to water quality. They affect amount of infiltration of surface precipitation into the ground and the amount of contaminants that may reach the groundwater, as well as the amount of surface stormwater runoff. In addition, these two factors affect the amount and content of pollutants and particles (including soil) that may wash into a water body, affecting its water quality, its aquatic plant community and its fishery. Further, soil types and soil slopes help determine the appropriate private sewage system and other engineering practices for a particular site, since they affect absorption, filtration and infiltration of contamination from engineering practices.

Figure 4: Parker Lake Watersheds Soils



CURRENT LAND USE

Both the surface and ground watersheds of Parker Lake are fairly small, as seen in the map and table below. The most common current land uses in the Parker Lake Surface Watershed are non-irrigated agriculture, woodlands and residential, in that order. In the ground watershed, the top two land uses are Woodlands and Residential (See Figures 5, 6a, 6b & 7).

Figure 5: Parker Lake Watersheds Land Use in Acres and Percent of Total

	Surface		**Ground**		**Total**	
Parker Lake	**Acres**		**Acres**		**Acres**	
Agriculture--Non Irrigated	310.91	33.03%	88.52	16.32%	399.43	26.86%
Agriculture--Irrigated	116.91	12.42%	82.23	15.17%	199.14	13.39%
Government	0	0.00%	40.67	7.46%	40.67	2.74%
Grassland/Pasture	65.61	6.97%	71.91	13.28%	137.52	9.25%
Residential	173.95	18.48%	106.28	18.78%	280.23	18.85%
Water	79.71	8.47%	15.29	2.80%	95	6.39%
Woodland	194.2	20.63%	140.71	26.19%	334.91	22.52%
total	941.29	100.00%	545.61	100.00%	1486.9	100.00%

Studies have shown that land use around a lake has a great impact on the water quality of that lake, especially in the amount and content of surface runoff. (James, T., 1992, I-10; Kibler, D.F., ed. 1982. 271) For example, while natural woodland may (on the average) absorb 3.5” out of a 4” rainfall, leaving only .5” as runoff, a residential area with quarter-acre lots may absorb only 2.3” of the 4”, leaving 1.7” to run off the land into the lake—the same amount as may be expected to run off from a corn or soybean field. 1.7” of runoff translates into 46,200 gallons per acre ending up in the lake! Percentage of impervious surface, the soil type, vegetation present and slope of the site can all affect runoff volume. (Frankenberger, J, ID-230).

Figure 6a: Land Use in Parker Lake Surface Watershed

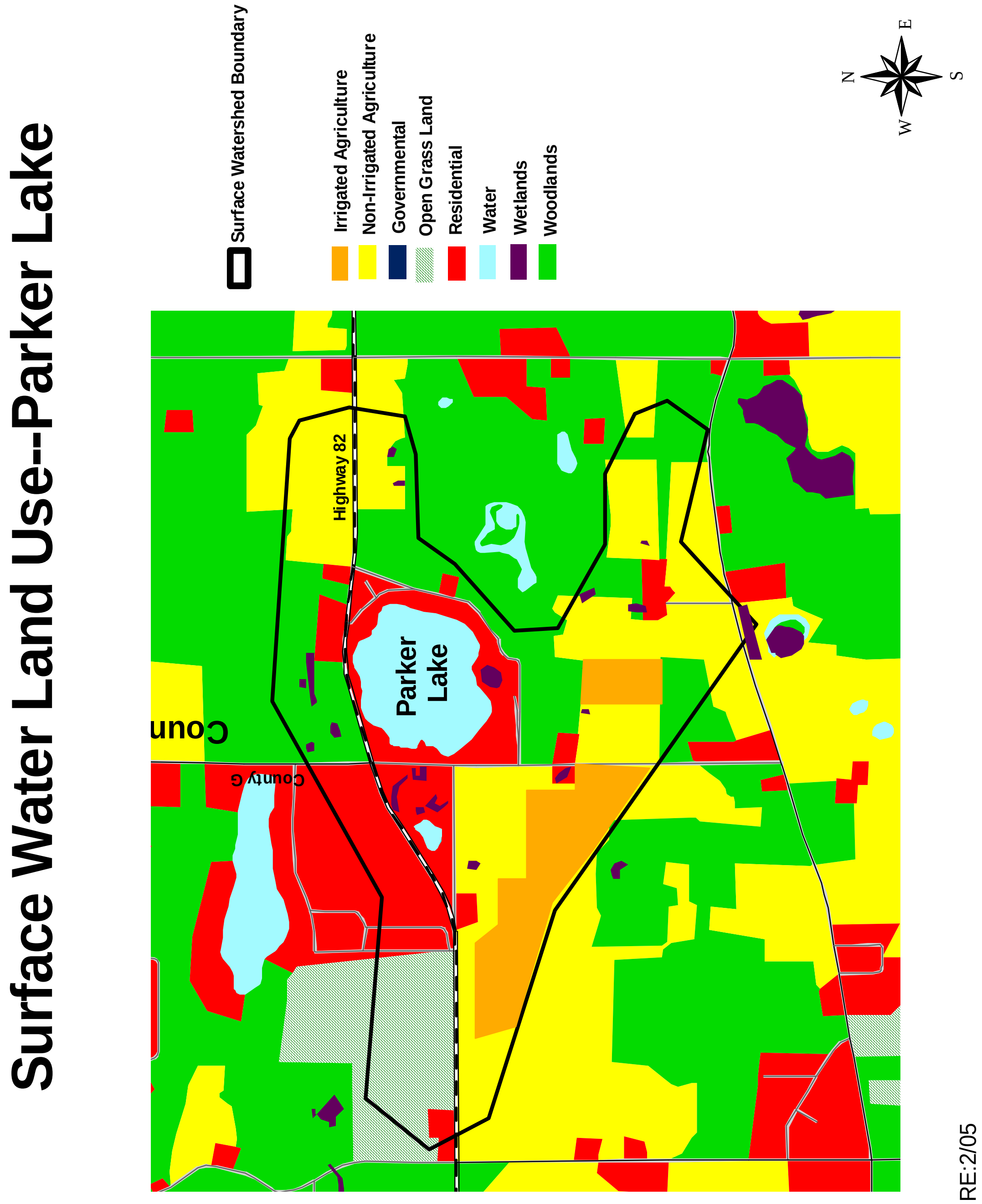
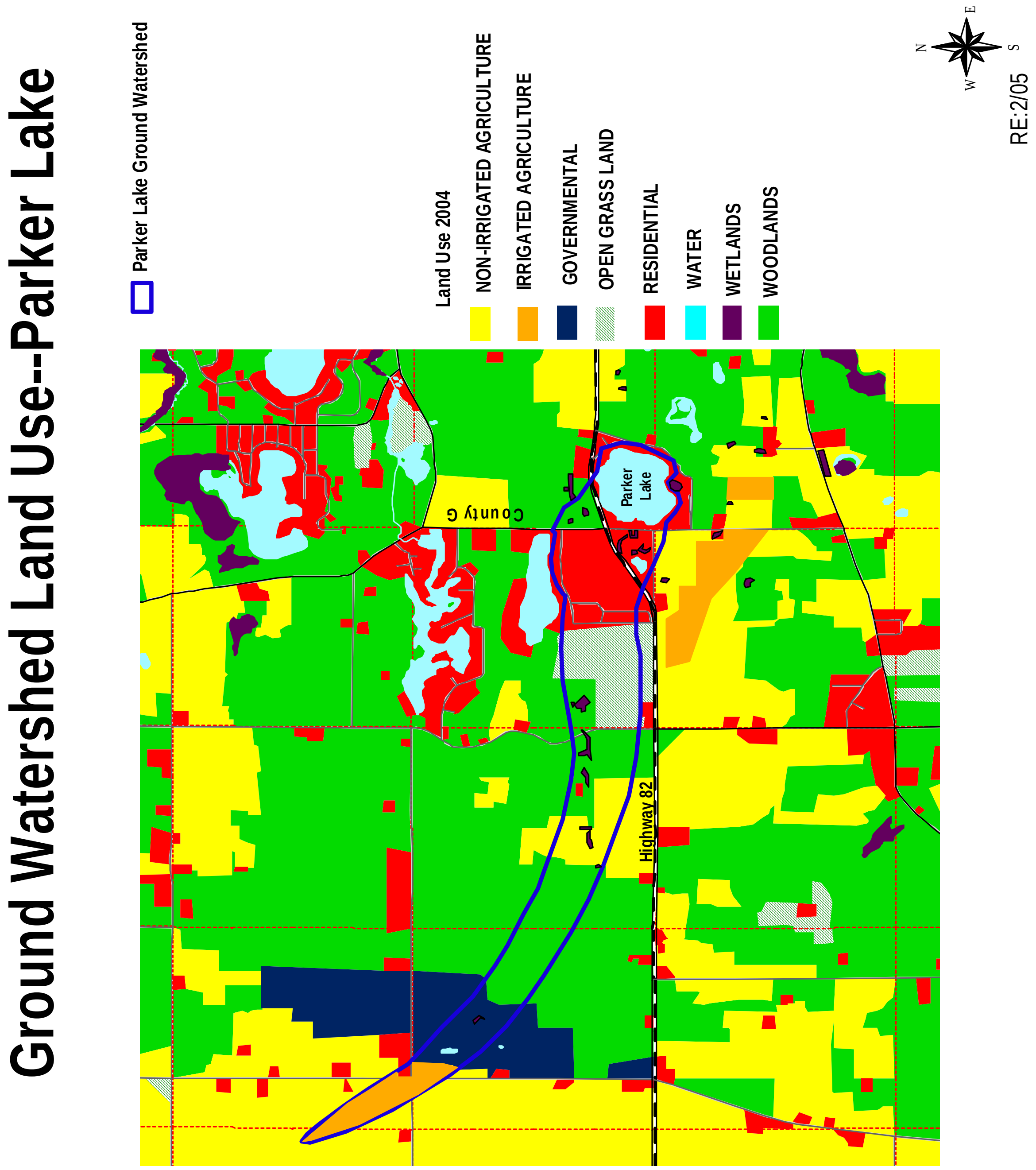
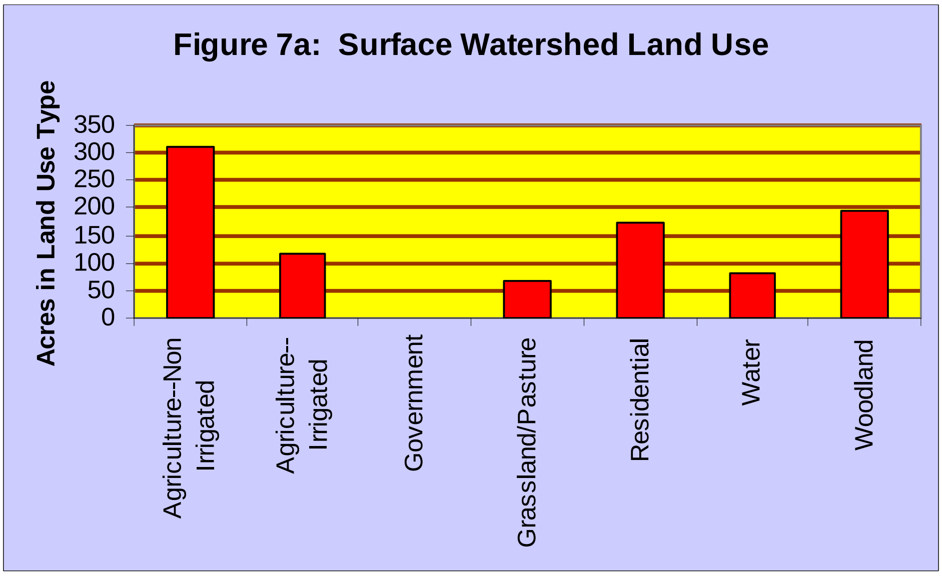
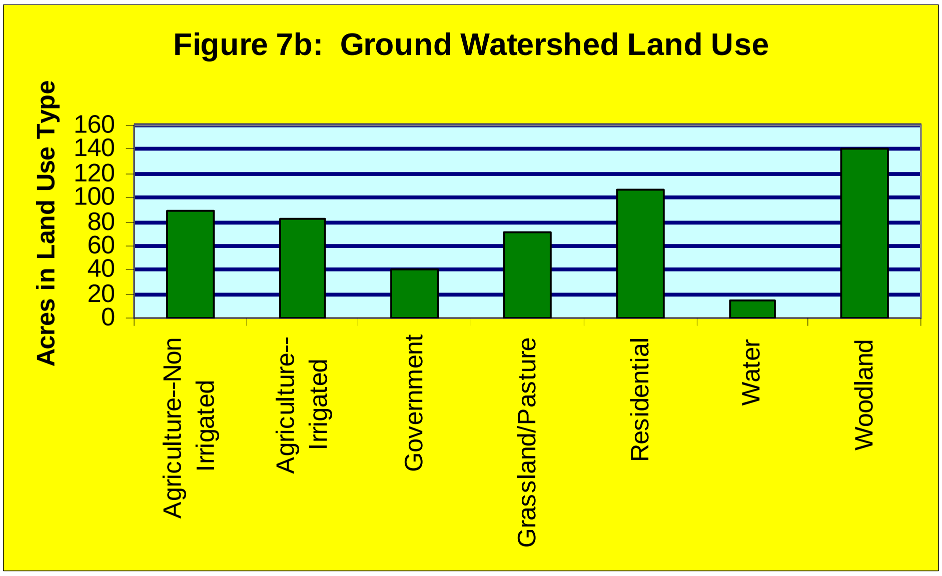


Figure 6b: Land use in Parker Lake Ground Watershed



When water runs over a surface, it picks up whatever loose pollutants—sediment, chemicals, metals, exhaust gas, etc—are present on that surface and takes those items with it into the lake. Increased development around a lake tends to increase the amount of pollutants being carried into the lake, thus negatively affecting water quality. Residential development areas with lots of one-quarter acre or less may deliver as much as 2.5 pounds of phosphorus per year to the lake for each acre of development.





SHORELANDS

Shorelands, the area defined by Wisconsin law as 1000 feet landward from the ordinary high water mark, are so important to water quality that they will be separately discussed. Parker Lake has a total shoreline of 1.16 miles (6125 feet). Most of the shore is in residential properties, including some older cabins that are quite close to the lake shore. Part of the north shore is a wayside owned by the Wisconsin Department of Transportation that includes a cement walkway going down to the lake. On the east shore is a small resort and beach.

Some of the shores are steep. In two places, the shore runs close to a road, leaving the potential for stormwater and road runoff to the lake. Water testing done between 2004 and 2006 showed that Parker Lake had about double the salinity level of other lakes in Adams County. Road runoff may be a factor in this salinity level, since a state highway (highway 82) and a county road run very close to the edge of Parker Lake.

Parker Lake has a total shoreline of 1.16 miles (6125 feet). Most of the shore is in residential properties, including some older cabins that are quite close to the lake shore. Part of the north shore is a wayside owned by the Wisconsin Department of Transportation that includes a cement walkway going down to the lake. On the east shore is a small resort and beach.

The Adams County Land & Water Conservation Department conducted a survey of the Parker Lake shoreline in 2004. Shore types were categorized as "armored" and "vegetated". "Vegetated" shores encompassed both native vegetation of any type and mowed lawns. Native vegetation covers 41.66% of Parker Lake's shoreline. Of the "armored" shores, mowed lawns cover 22.92% and hard structure (piers, etc.) covers 23.37% of the total shore. The remaining 12.15% is bare sand.

Figure 8: Shore Types on Parker Lake

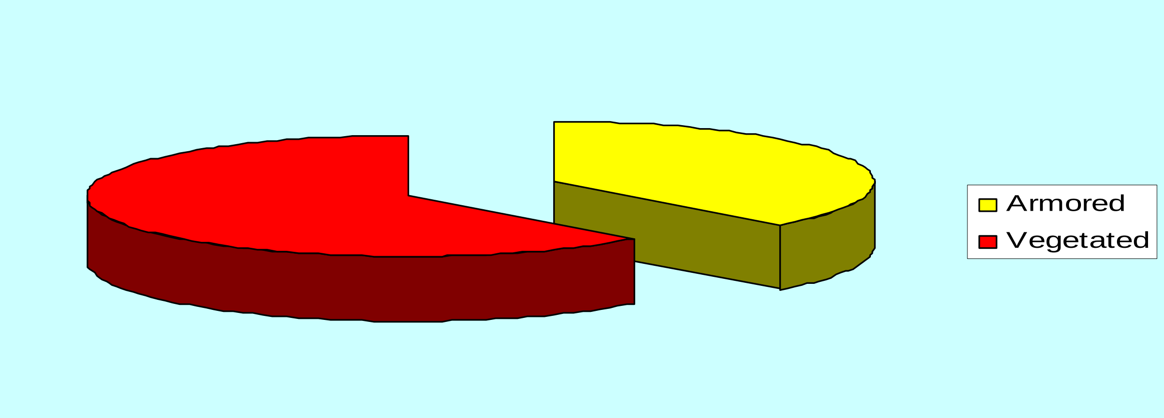
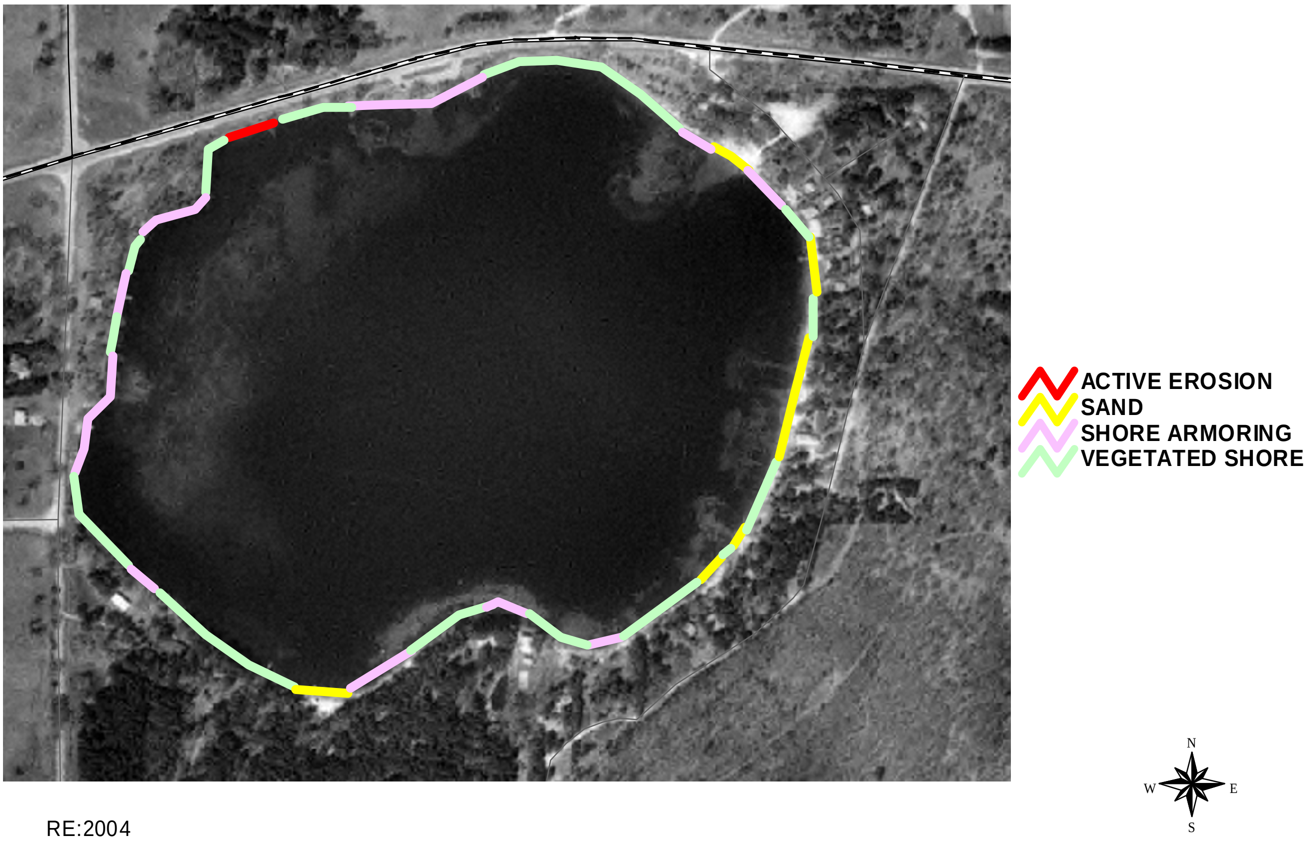
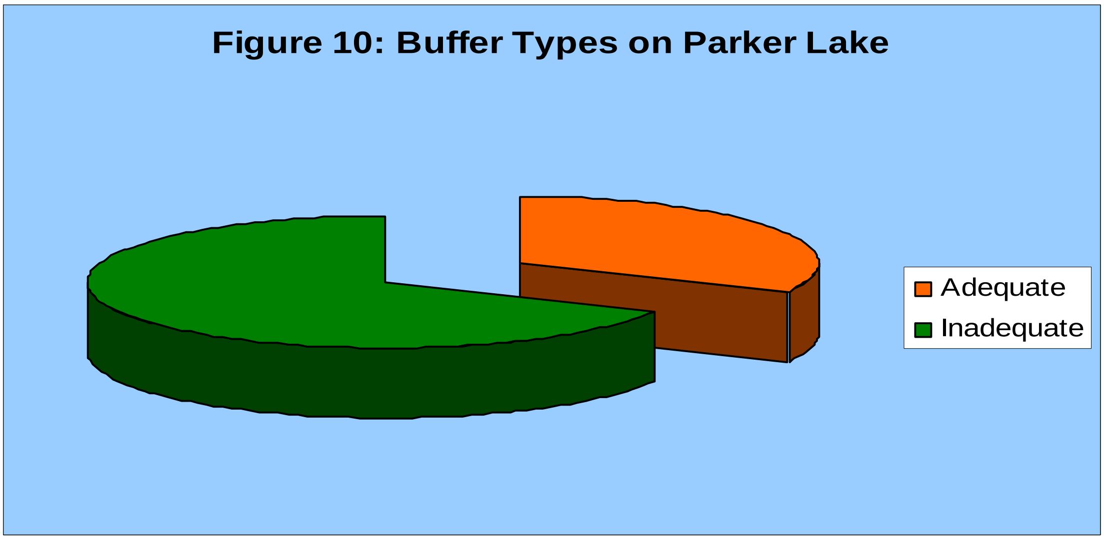


Figure 9: Shoreline of Parker Lake (2004)



Under the Adams County Shoreland Ordinance, the first 35 feet landward from the water is a “buffer.” Shoreland buffers are an important part of lake protection and restoration. These buffers are simply a wide border of native plants, grasses, shrubs and trees that filter and trap soil & similar sediments, fertilizer, grass clippings, stormwater runoff and other potential pollutants, keeping them out of the lake. A 1990 study of Wisconsin shorelines revealed that a buffer of native vegetation traps 5 to 18 times more volume of potential pollutants than does a developed, traditional lawn or hard-armored shore.

The 2004 inventory included classifying areas of the Parker Lake shorelines as having “adequate” or “inadequate” buffers. An “adequate” buffer was defined as one having the first 35 feet landward covered by native vegetation. An “inadequate” buffer was anything that didn’t meet the definition of “adequate buffer”, including native vegetation strips less than 35 feet landward. Using these definitions, only 31.1% (1995.07 feet) of Parker Lake’s shoreline had an “adequate buffer”, leaving 67.9% (4219.73 feet) as “inadequate.” Most of the “inadequate” buffer areas were found with mowed lawns and/or insufficient native vegetation at the shoreline to cover 35 feet landward from the water line.

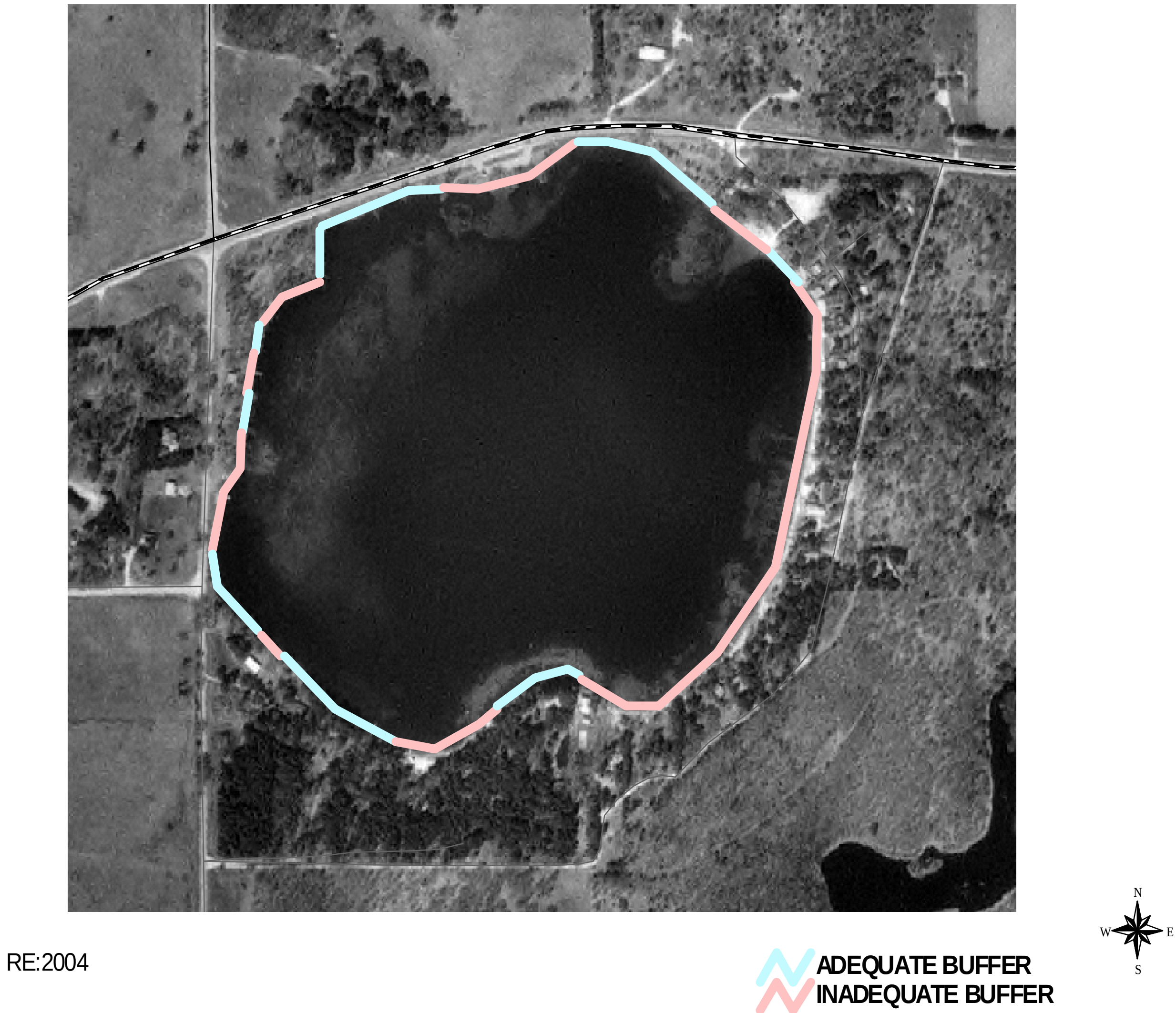


Vegetated shoreland buffers help stabilize shoreline banks, thus reducing bank erosion. The plant roots give structure to the bank and also increase water infiltration and decrease runoff. A vegetated shore is especially important when shores are steep and soft, as are many of the Parker Lake shores. Figure 11 maps the adequate and inadequate buffers on Parker Lake.

Lakeside buffers also serve as important habitat. Lake edges usually contain aquatic and wetland plants, grading into drier groundcover, then shrubs and trees as one moves inland towards drier land. Buffers provide habitat for many species of water-dependent wildlife, including furbearers, reptiles, birds and insects. Many wildlife species, including birds, small mammals, fish & turtles breed, nest, forage and/or perch in shore buffer areas. Further, 80% of the endangered and threatened species listed spend part of their life in this near-lake buffer area. (Wagner et al, 2006)

When the natural shoreline is replaced by traditional mowed turf-grass lawns, rock, wooden walls or similar installments, bird and animal life, land-based insects, and aquatic insects that hatch or winter on natural shore are negatively impacted. For example, on many Adams County lakes, the non-native aquatic plant, Eurasian Watermilfoil has invaded. There is a weevil native to Wisconsin that weakens Eurasian Watermilfoil by burrowing into and developing within its stems, but that weevil depends on a native-plant shore to overwinter. If the shore is instead covered by rock, seawall or traditional lawn, these weevils will be unavailable for the lake to use as Eurasian Watermilfoil control.

Figure 11: Buffer Categories on Parker Lake



The filtering process and bank stabilization that buffers provide help improve a lake's water quality, including water clarity. Studies in Minnesota, Maine and Michigan have shown that waterfront property value increases for every foot the water clarity of a lake increases. (Krysel et al, 2003).

Figure 12a: Example of Inadequate Buffer

Figure 12b: Example of Adequate Buffer

Natural shoreland buffers serve important cultural functions. They enhance the lake's aesethics. Studies have shown that aesthetics rank high as one of the reasons people visit or live on lakes. Shore buffers can provide visual & audio privacy screens for homeowners from other neighbors and/or lake users.

Adequate buffers on Parker Lake could be easily installed on most of the lake by either letting the first 35 feet landward from the water just grow without mowing it, except for a path to the water, or—if something more controlled or aesthetically pleasing was desired—by planting native seedlings sufficient to fill in the first 35 feet.

WATER QUALITY

Between 2004 and 2006, Adams County Land & Water Conservation Department gathered water chemistry and other water quality information on 20 lakes in Adams County with public access. Parker Lake was one of these lakes. Part of the information was gained from periodic water sampling done by Adams County LWCD. Historic information about water testing on Parker Lake was also obtained from the WDNR (1992-2004), as well as limited Self-Help Monitoring from 1990 through 2004 and some private testing from 1986 to 1992.

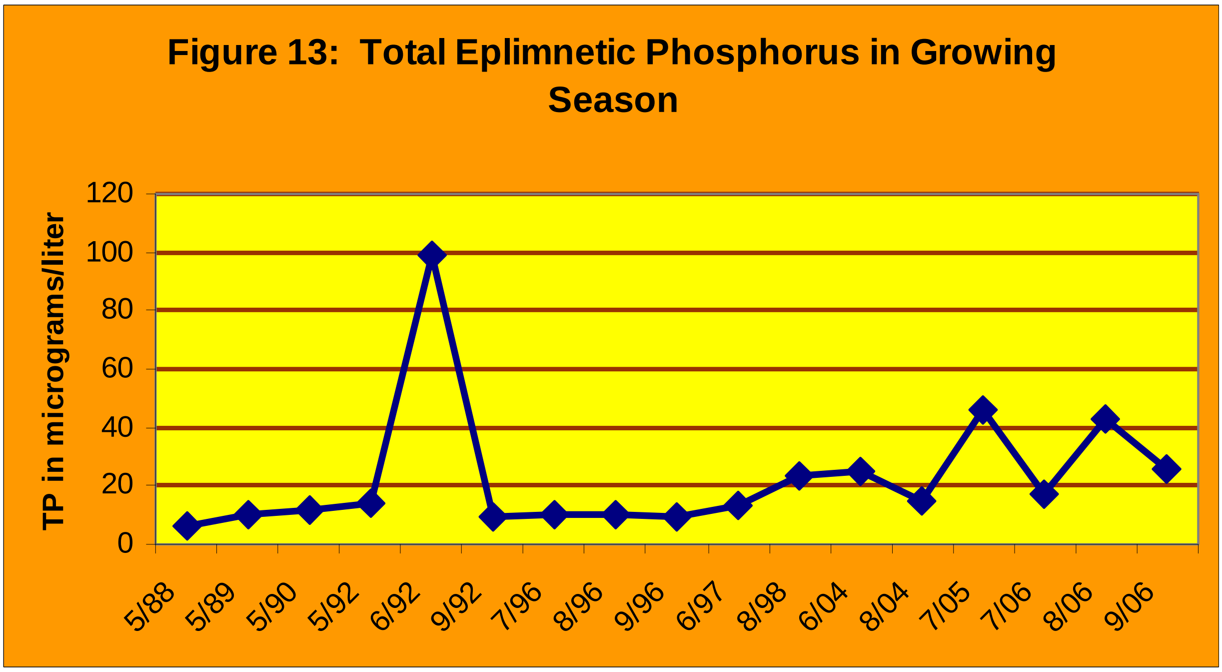
Phosphorus

Most lakes in Wisconsin, including Parker Lake, are phosphorus-limited lakes: of the pollutants that end up in the lake, the one that most affects the overall quality of the lake water is phosphorus. The amount of phosphorus especially affects the frequency and density of aquatic vegetation and the frequency and density of various kinds of algae, as well as water clarity and other quality aspects. One pound of phosphorus can produce as much as 500 pounds of algae.

Phosphorus is not an element that occurs in high concentration naturally, so any lake that has significant phosphorus readings must have gotten that phosphorus from outside the lake or from internal loading. Some phosphorus is deposited onto the lake from atmospheric deposition, especially from soil or other particles in the air carrying phosphorus. A lake that includes a flooded wetland area may have a significant amount of phosphorus being released during the flushing of the wetland area. Phosphorus may accumulate in sediments from dying animals, dying aquatic plants and dying algae. If the bottom of the lake becomes anoxic (oxygen-depleted) or hypoxic (low oxygen), chemical reactions may cause phosphorus to be released into the water column.

Although there are several forms of phosphorus in water, the total phosphorus (TP) concentration is considered a good indicator of a lake's nutrient status, since the TP concentration tends to be more stable than other types of phosphorus concentration. For a natural lake like Parker Lake, a total phosphorus concentration below 20 micrograms/liter tends to reduce nuisance algal blooms. Parker Lake's growing season (June-September) surface average total phosphorus level of 21.61 micrograms/liter is low enough so that nuisance algal blooms should occur only rarely and are probably localized. This is higher than the readings taken during the growing seasons from 1988 through 1990, when the average surface total phosphorus level was 11 micrograms/liter. It appears that phosphorus is increasing in Parker Lake.

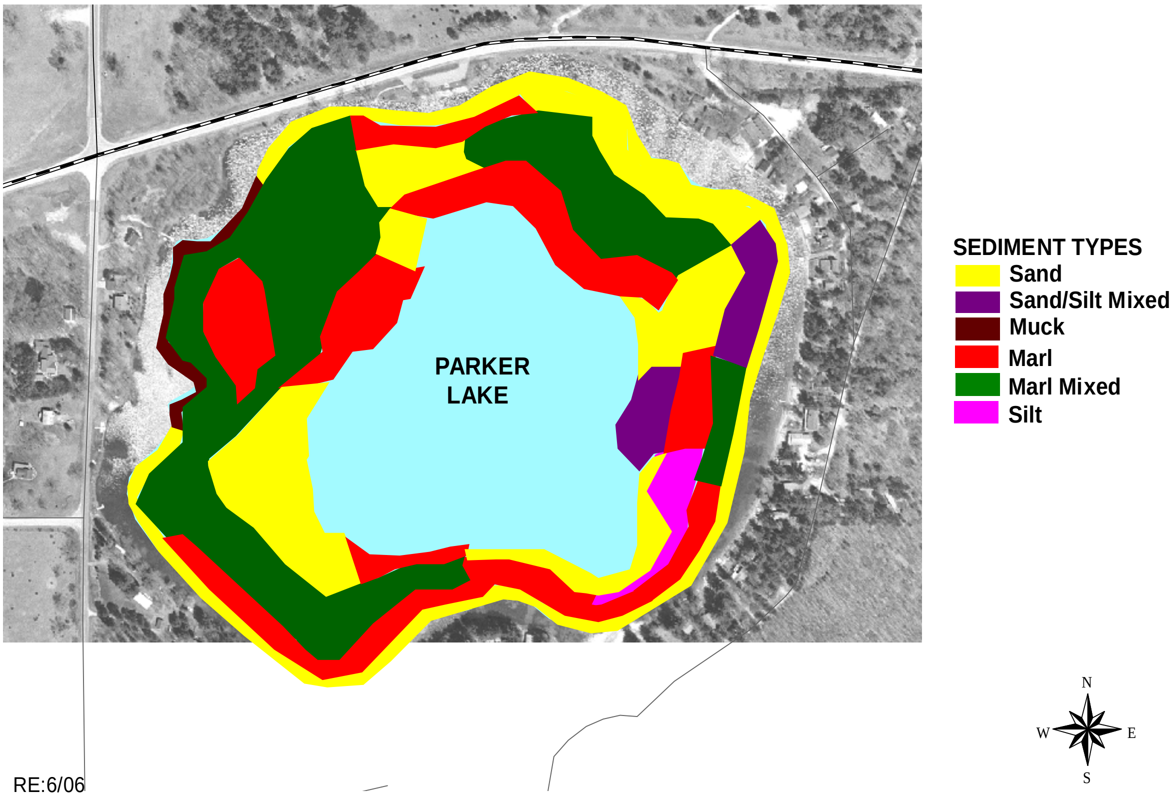
Since the limiting factor in most Wisconsin lakes, including Parker Lake, is phosphorus, measuring the phosphorus in a lake system thus provides an indication of the nutrient level in a lake. Increased phosphorus in a lake will feed algal blooms and also may cause excess plant growth. The 2004-2006 summer average phosphorus concentration in Parker Lake was 21.61 micrograms/liter. This is below the 25 micrograms/liter average for natural lakes in Wisconsin to avoid nuisance algal blooms.



As the above graph (Figure 13) indicates, the recent growing season total phosphorus levels have varied, but stayed below the 20 micrograms/milliliter recommended to avoid nuisance algal blooms until 2004 (not counting the unexplained spike in 8/92).. However, considering that the overall line since 1988 has been showing slightly increased total phosphorus levels for the growing season, phosphorus should continue to be monitored.

In most lakes in Wisconsin, phosphorus concentration in the bottom sediments of the lake is considerably higher than the concentration in the water column itself. Bottom sediments can "bind up" phosphorus, making it unavailable for aquatic plants or algae to use. Some sediment types hold phosphorus at a higher rate than others.

Figure 14: Sediments in Parker Lake



As can be seen on the sediment map (Figure 14), some of the bottom of Parker Lake is marl sediment or marl mixed with another sediment type (sand/silt/peat). “Marl” is a calcium carbonate precipitate (solid) that forms in hard water lakes when both calcium and pH levels are high. Marl can be good for a lake because it has a high capacity to bind phosphorus, as well as other nutrients. With such a large amount of marl sediment (35.32% of littoral zone), Parker Lake may be benefitting from it removing phosphorus from water column, thus making it unavailable for algal and aquatic plant growth.

How much a marl sediment affects aquatic plant and algal growth will depend on where the marl sediment is located, i.e., if the aquatic plants are rooted in the marl, so that they can still draw phosphorus from it, the presence of marl may not reduce aquatic plant growth. Effect will also depend on how much phosphorus the marl has already absorbed. In 80% of Wisconsin’s lakes, phosphorus is the key nutrient that determines the amount of algae and aquatic plant growth. Since much of the marl in

Parker Lake is in the littoral zone of the lake, the marl sediment offers some protection against both nuisance algal growth and nuisance aquatic plant growth.

Groundwater testing of various wells around Parker Lake was done by Adams County LWCD and included a test one year (2006) for total phosphorus levels in the groundwater coming into the lake. The average TP level in the wells tested was 24.8 micrograms/liter, considerably higher than the lake surface water results. This phosphorus may also seep into Parker Lake and be a contributor to phosphorus accumulation.

Land use plays a major role in phosphorus loading. A key component of the computer models used is the phosphorus budget, that is, the estimated amount of phosphorus delivered to the lake from each land use type annually. The land uses that contribute the most phosphorus are irrigated & non-irrigated agriculture. Using the current land use data, as well as phosphorus readings from 2004 through 2006 water sampling, a phosphorus loading prediction model was run for Parker Lake. The current results are shown in the table below:

Figure 15: Current Phosphorus Loading by Land Use

MOST LIKELY PHOSPHORUS LOADING		
BY LAND USE	%	current
Agriculture--Non Irrigated	49.4%	110
Agriculture--Irrigated	23.2%	52.8
Grassland/Pasture	3.9%	8.8
Residential	1.9%	4.4
Woodland	3.9%	8.8
Groundshed	10.8%	24.2
Lake Surface	3.7%	8.8
Septic	3.2%	7.26
Total in pounds/acre	100.0%	225.06

Phosphorus deposits such as that from flooded wetlands or from atmospheric deposition cannot be controlled by humans. However, some phosphorus (and other nutrient) input can be decreased or increased by changes in human land use patterns. Practices such as shoreland buffer restoration; infiltrating stormwater runoff from roof tops, driveways and other impervious surfaces; using no phosphorus lawn fertilizers; and reducing phosphorus input to and properly managing septic systems will minimize phosphorus inputs into the lake. Circumstances such as increased impervious surface, lawns mowed to water's edge, disturbance of shore areas, improperly-functioning septic systems and removal of native vegetation can greatly increase the volume and content of runoff—and thus increase the volume of phosphorus entering the lake. Many of these practices can also increase the concentration of phosphorus entering the lake, by runoff or other methods of entry.

The models were run using not only the current known phosphorus readings in the lake, but also representing decreases or increases of human-controlled phosphorus input by 10%, 25%, and 50%. The figures may not seem like much---until you calculate that one pound of phosphorus can result in up to 500 pounds of algae. A 10% reduction in these three areas could result in 9935 pounds less of algae per year!

Figure 16: Impact of Changes in Overall Phosphorus Input

LAND USE		current	-10%	-25%	-50%
Agriculture--Non Irrigated		110	99.00	82.50	55.00
Agriculture--Irrigated		52.8	47.52	39.60	26.40
Grassland/Pasture		8.8	8.80	8.80	8.80
Residential		4.4	3.96	3.30	2.20
Woodland		8.8	8.80	8.80	8.80
Groundshed		24.2	21.78	18.15	12.10
Lake Surface		8.8	8.80	8.80	8.80
Septic		7.26	6.53	5.45	3.63
Total in pounds/acre		225.06	205.19	175.40	125.73

Looking at this issue in terms of how much phosphorus readings in the lake might change, based on the computer modeling, in-lake perhaps makes it clearer. Figure 16 shows that the effect of 10%, 25% and 50% decrease to human-impacted phosphorus within the lake.

Reducing the amount of input from the surface and ground watersheds results in less nutrient loading into the lake itself. Under the modeling predictions, reducing phosphorus inputs from human-based activities even 10% could improve Parker Lake water quality by up to 9 micrograms of phosphorus/liter; a 25% reduction could save up to 21 micrograms/liter (see Figure 17). These predictions make it clear that reducing current phosphorus inputs to the lake are essential to improve, maintain and protect Parker Lake's health for future generations.

Figure 17: In-Lake Impact of Phosphorus Reduction

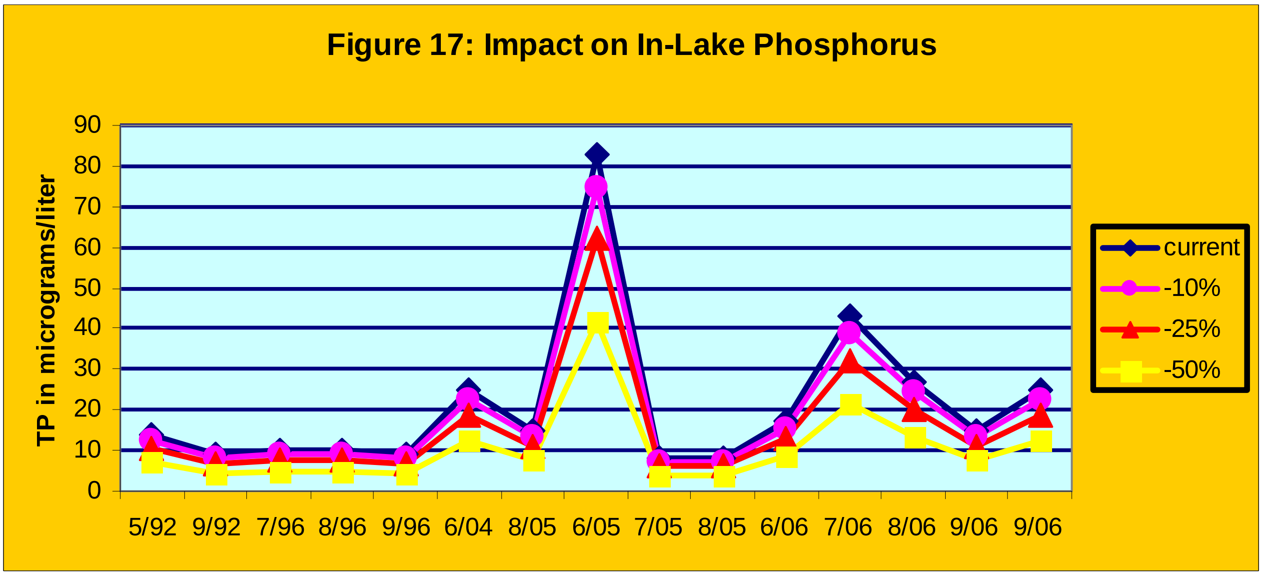
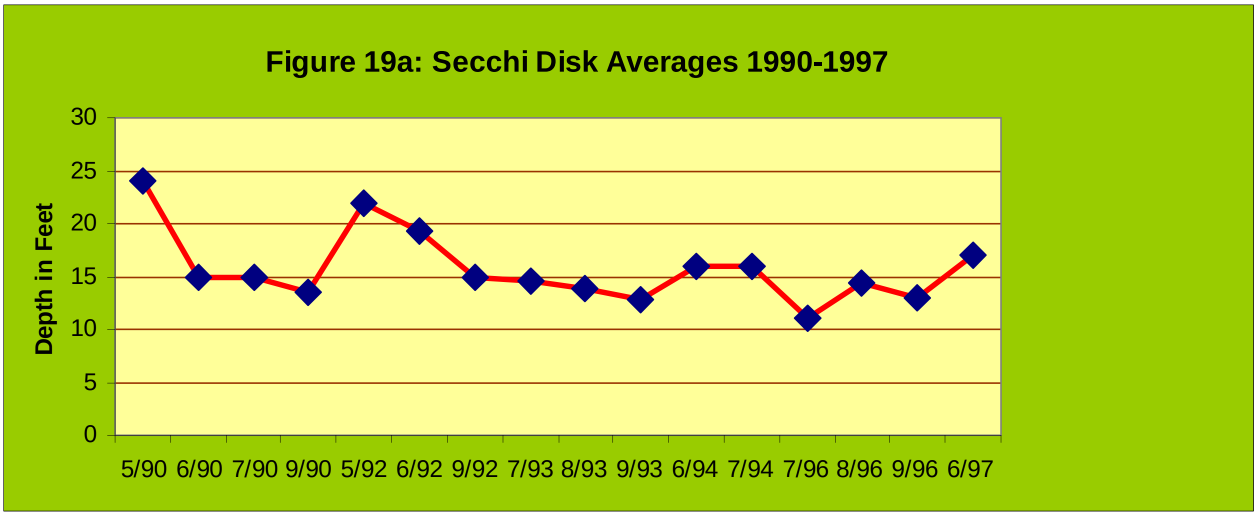


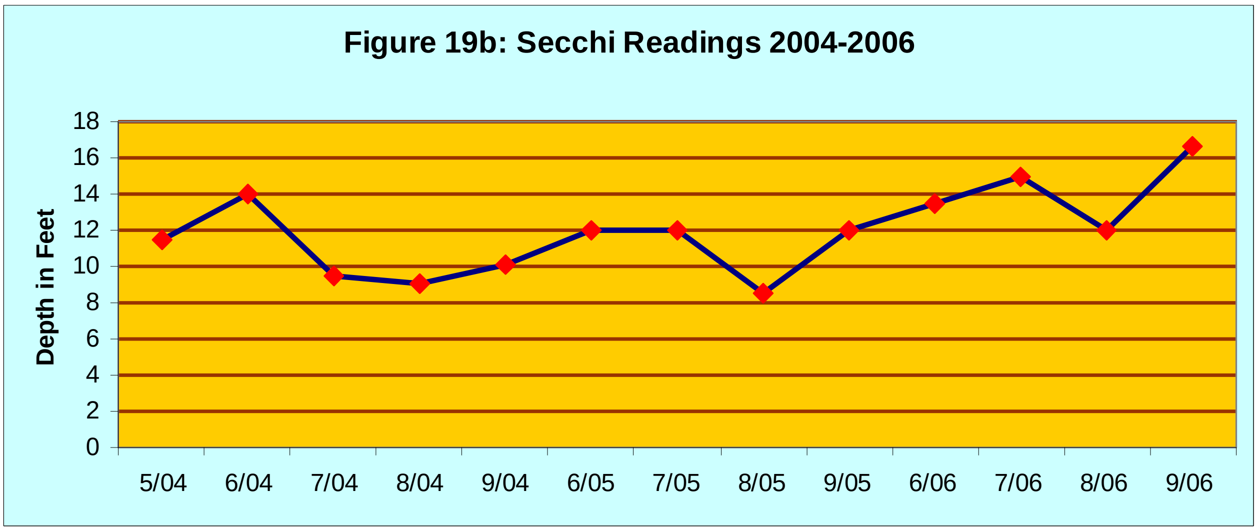
Figure 18: Photo of a Lake with Algal Bloom

Water Clarity

Water clarity is a critical factor for plants. If plants don't get more than 2% of the surface illumination, they won't survive. Water clarity can be reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color or cloud the water. Water clarity is measured with a Secchi disk. Average summer Secchi disk clarity in Parker Lake in 2004-2006 was 11.95 feet. This is very good water clarity, putting Parker Lake into the "oligotrophic" category for water clarity. Records since 1990 show that the water clarity in Parker Lake has consistently remained high (see Figures 19a & 19b).

Figure 19: Average Summer Secchi Disk Readings in Parker Lake

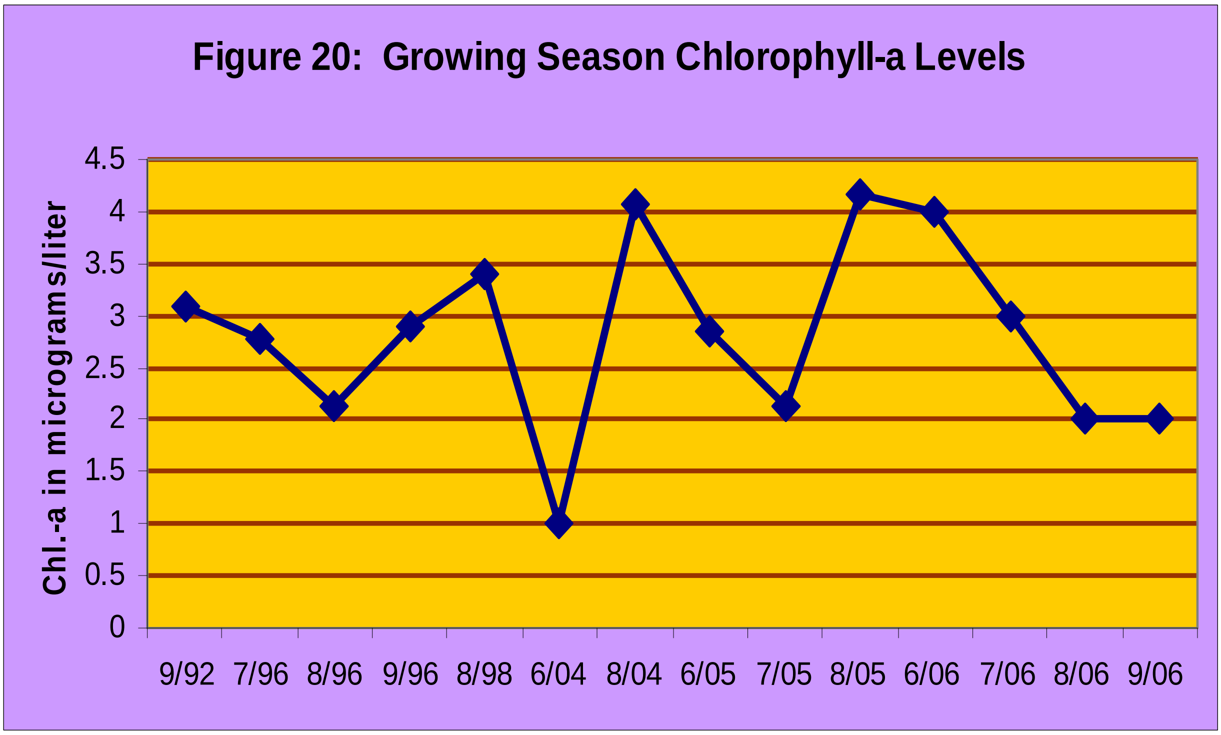




Chlorophyll a

Chlorophyll-a concentrations provide a measurement of the amount of algae in a lake's water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth, as well as result in unpleasing odor and appearance. Studies have shown that the amount of chlorophyll a in lake water depends greatly on the amount of algae present; therefore, chlorophyll-a levels are commonly used as a water quality indicator. The 2004-2006 summer (June-September) average chlorophyll concentration in Parker Lake was 4.44 microrams/liter. This low algae concentration places Parker Lake at the "oligotrophic" level for chlorophyll a results.

Chlorophyll-a averages have stayed low since 1992, the first year for which records were found, and have remained very low between 2004 and 2006, when the Adams County LWCD was monitoring the lake.

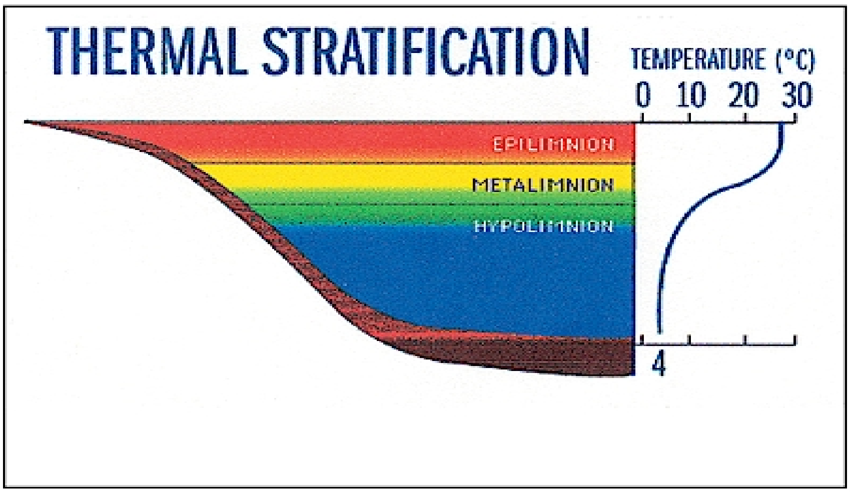


Dissolved Oxygen

Oxygen dissolved in the water is essential to all aerobic aquatic organisms. The oxygen in a lake comes from the atmosphere and from the process of photosynthesis. Aquatic plants and algae consume carbon dioxide and respirate oxygen back into the lake water. The distribution of oxygen within a lake is affected by many factors, including water circulation, water stratification, winds or storms, air temperature; water temperature, nutrient availability, and the density and location of algae and/or aquatic plants.

Oxygen consumption in the sediment and the water just above it (hypolimnion) is more sensitive that those in the two upper layers of water (metalimnion and epilimnion) because the bottom consumption is less likely to be balanced by the circulation and photosynthesis output available to the upper layers.

Figure 21: Lake Stratification Layers



Low oxygen during the summer in the bottom waters of a lake occurs naturally as oxygen in the bottom layer is consumed, but not replenished. It is common that as the summer progresses, the oxygen concentration of the bottom waters decreases. In Parker Lake, there were hypoxic periods in the depths from 20’ to 50’ during the summers of 2004 and 2005. By end of summer 2005 (September), dissolved oxygen concentration at 30’+ depth was only 3.2 mg/l. And in 2004, in August, dissolved oxygen concentration at the same depth was only .6 mg/l. This pattern was not present in 2006 when oxygen levels at all depths were over 5 mg/l (the minimum level for most fish survival). The charts (Figures 22a, b, c) below show the annual (2004-2006) variations in dissolved oxygen levels in milligrams/liter, depth in feet and months of the year:

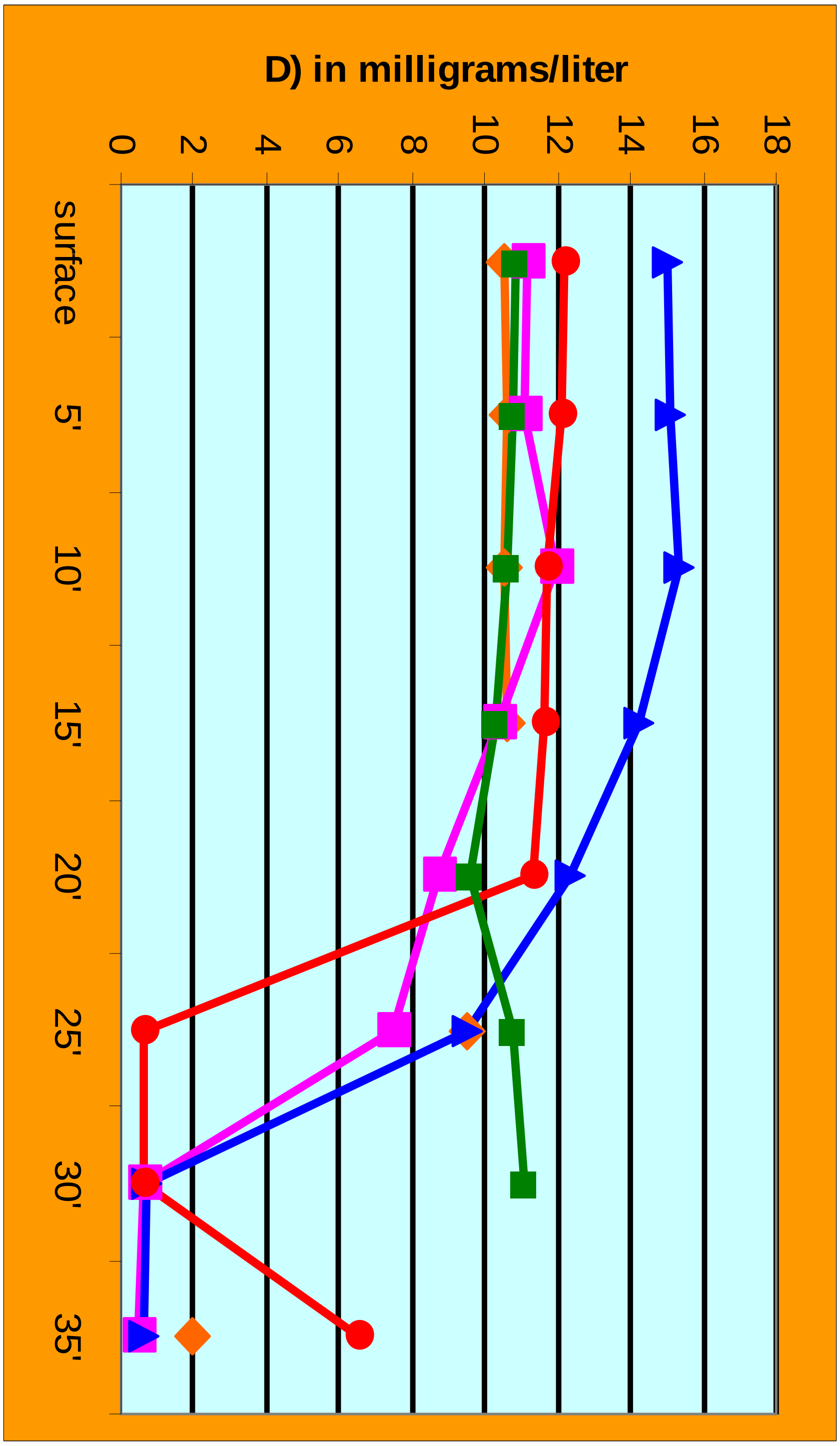


Figure 22a: Dissolved Oxygen Levels During 2004 Water Testing in milligrams/liter

Figure 22b: Dissolved Oxygen Levels During 2005 Water Testing in milligrams/liter

2/05

4/05

6/05

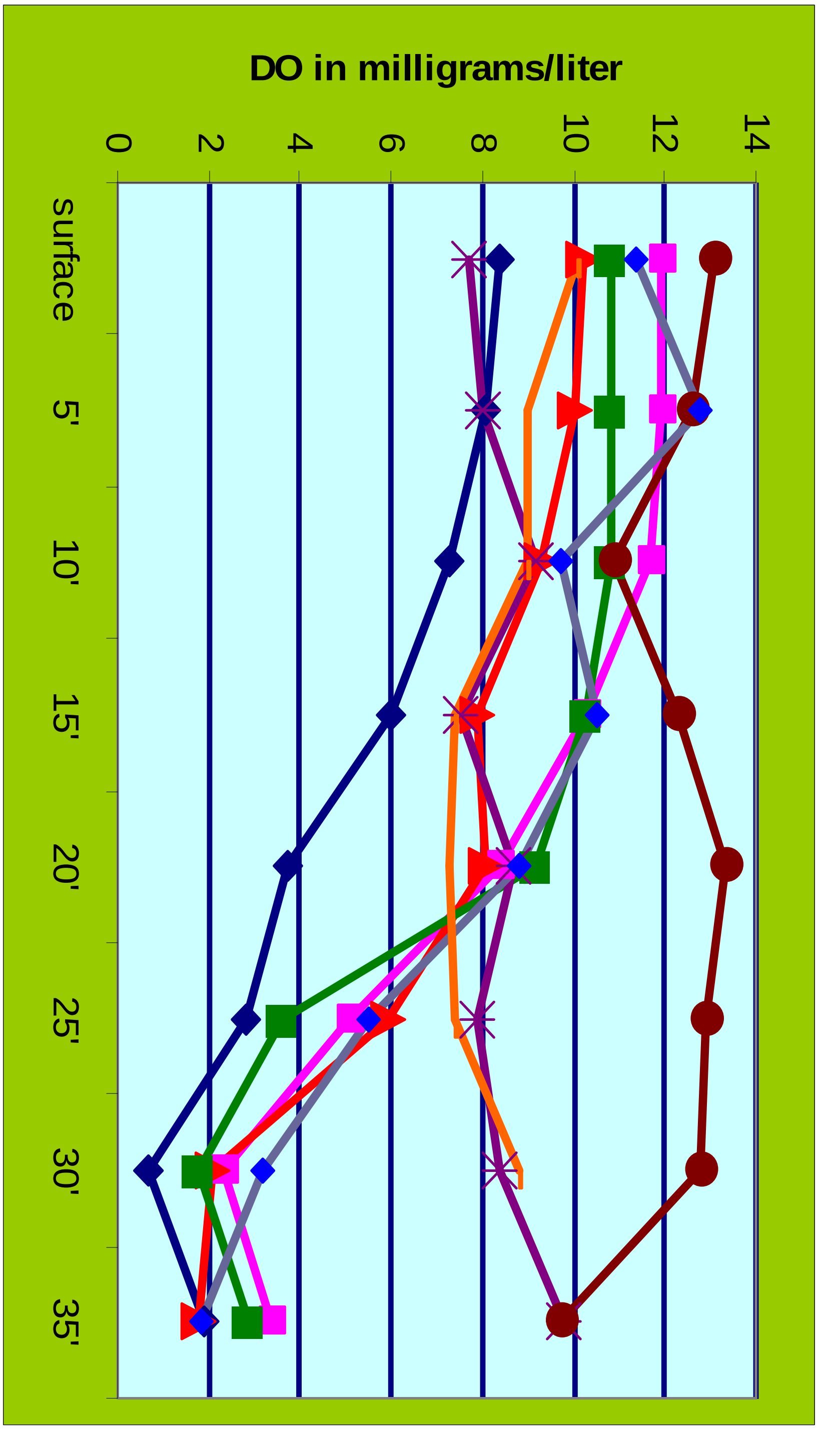
7/05

8/05

9/05

9/05

11/05



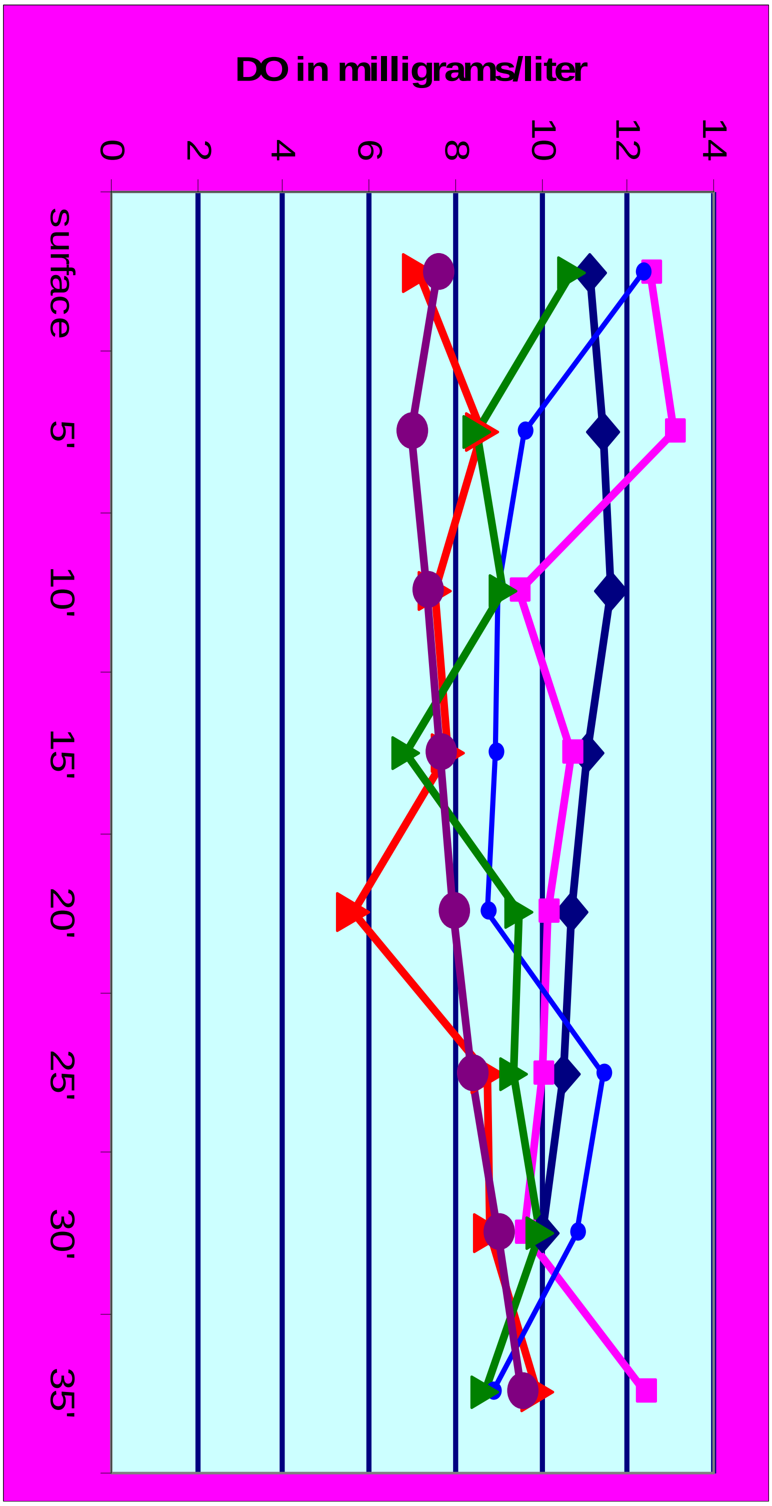
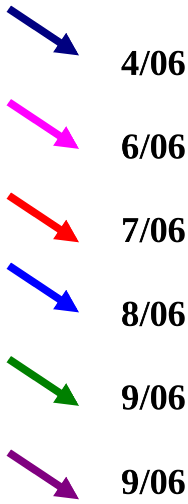


Figure22c: Dissolved Oxygen Levels During 2006 Water Testing in milligrams/liter



By autumn, when the surface waters have cooled and water density throughout the water column is the same, the water column mixes vertically, a process known as “fall turnover.”

Human activity can aggravate the development of low oxygen (hypoxic) or no oxygen (anoxic) in the bottom waters. For example, the addition of phosphorus usually leads to an increase in the growth of algae and aquatic plants—both of which consume oxygen during their photosynthesis. It has also been hypothesized that hypoxia or anoxia can be affected by climate changes, such as a longer and/or warmer summer, low lake levels, and changes in water temperature due to cover (i.e., shore vegetation) being removed.

The development of hypoxia or anoxia can have negative effects. The first effect usually noticed by human is fish kills. Fish kills result when fish species that need cold oxygen-rich water to survive can’t find it in the lake anymore or when some of their invertebrate food (such as mayfly nymphs) is gone due to low oxygen levels. Another noticeable effect can be an increase in the frequency and distribution of algal blooms. In some instances, anoxia can lead to blooms of toxic algae and the production of water-borne toxins that can harm humans and wildlife. Anoxia sometimes also leads to increased phosphorus cycling, undesirable water taste or odor levels, and interference with recreational uses such as swimming, boating and fishing.

As noted above, summer hypoxia or anoxia can result in phosphorus being released into the upper water column and being available for algal blooms and increased aquatic plant growth. The results from 2004 through 2006 (the only years for which data is available) don’t show that summer hypoxia/anoxia in the lower depths is always a problem in Parker Lake, but it did show up in two of the three years.

The data from 2004-2006 (see Figures 22a, b, c) shows there is potential for phosphorus loading from the lower depths (hypolimnion) during the summer months in Parker Lake if the hypoxia/anoxia continues. Dissolved oxygen needs to be monitored during the late summer months in the lower depths on Parker Lake to determine whether hypoxia/anoxia is a frequently-occurring condition that may need to be addressed by management practices.

Water Hardness, Alkalinity and pH

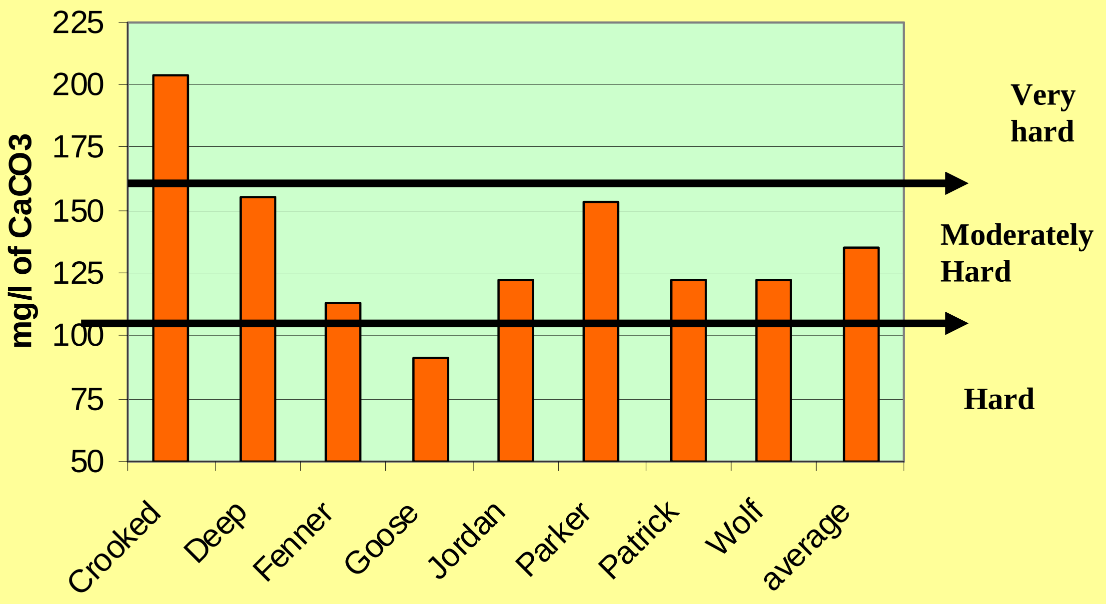
Testing done by Adams County LWCD on Parker Lake included annual testing for water alkalinity and water hardness. Hardness and alkalinity levels in a lake are affected by the soil minerals, bedrock type in the watershed, and frequency of contact between lake water & these materials.

Level of Hardness	Mg/l CaCO3
SOFT	0-60
MODERATELY HARD	61-120
HARD	121-180
VERY HARD	>180

Figure 23: Levels of Hardness in Mg/l of Calcium Carbonate

One method of evaluating hardness is to test the water for the amount of calcium carbonate ($CaCO_3$) it contains. The surface water of all of the public access lakes in Adams County is moderately hard to very hard. In 2005 and 2006, random samples were also taken of wells around Parker Lake to measure the hardness of the water coming into the lake through groundwater. Hardness in the groundwater ranged from 140 (hard) to 304 (very hard). The hardness in both surface and groundwater is likely due to the underlying bedrock in Adams County, which is mostly sandstone with pockets of dolomite and shale.

Figure 24: Hardness of Adams County Natural Lakes



As the graph (Figure 24) shows, Parker Lake surface water testing result for 2004 through 2006 showed “hard” water” (average 153 mg/l of CaCO3), with higher hardness than the average for Adams County’s natural lakes (135 mg/l of Calcium Carbonate). Water testing in the 1990s indicated an average of 155 mg/l of Calcium Carbonate), similar to the 2004-2006 average. Hard water lakes tend to produce more fish and aquatic plants than soft water lakes because they are often located in watersheds with soils that load phosphorus into the lake water.

However, hard water lakes also often have marl sediments that precipitate the phosphorus out, serving to help balance the phosphorus loaded from the watershed. Hardness levels over 180 mg/l can cause marl to start precipitating out of the water or sediment, thus releasing phosphorus for aquatic plant and algae use. Since Parker Lake’s hardness less is above that number, the marl sediments in the lake may release phosphorus into in the water column.

Alkalinity is important in a lake to buffer the effects of acidification from the atmosphere. “Acid rain” has long been a problem with lakes that had low alkalinity level and high potential sources of acid deposition.

Acid Rain Sensitivity	ueq/l CaCO3
High	0-39
Moderate	49-199
Low	200-499
Not Sensitive	>500

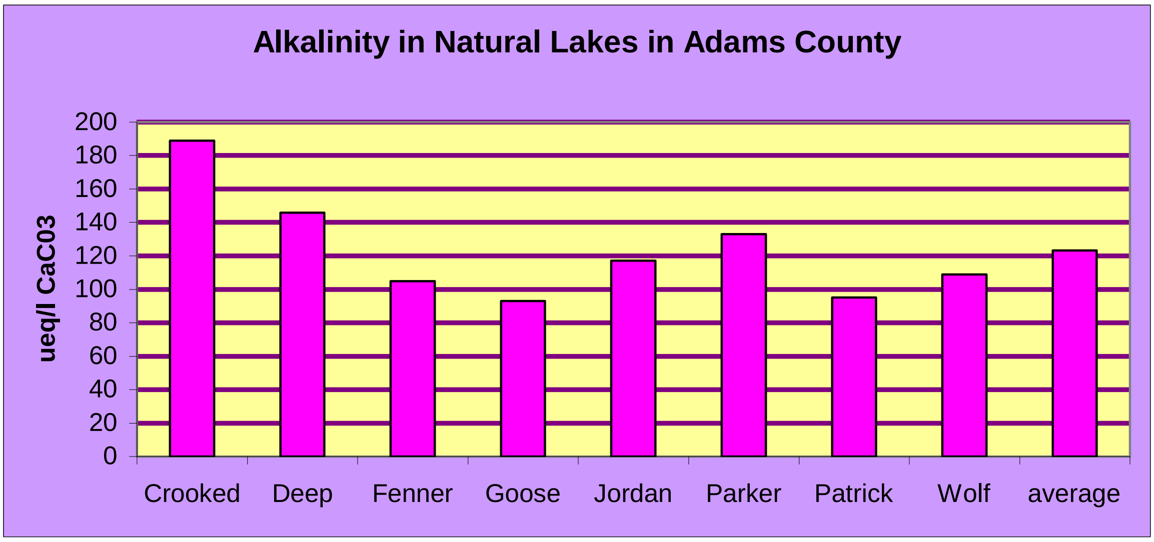
Figure 25: Acid Rain Sensitivity

Well water testing results ranged from 144 ueq/l to 294 ueq/l in alkalinity, resulting in an average of 204 ueq/l., considerably higher than the surface water average of 136 ueq/l. Parker Lake’s potential sensitivity to acid rain is low to moderate, but luckily for Adams County, the acid deposition rate is very low, probably due to the little industrialization in the county.

Alkalinity also affects the pH level of lake water. The acidity level of a lake’s water regulates the solubility of many minerals. A pH level of 7 is neutral. The pH level in Wisconsin lakes ranges from 4.5 in acid bog lakes to 8.4 in hard water, marl lakes.

Some of the minerals that become available under low pH, especially the metals aluminum, zinc and mercury, can inhibit fish reproduction and/or survival. Even what seems like a small variance in pH can have large effects because the pH scale is set up so that every 1.0 unit change increases acidity tenfold, i.e., water with a pH of 7 is 10 times more acid than water with pH of 8. Mercury and aluminum are not only toxic to many kinds of wildlife; they can also be toxic to humans, especially those that eat tainted fish.

Figure 26: Alkalinity in Natural Lakes in Adams County



The testing occurring from 2004-2006 also included regular monitoring of the pH at several depths in Parker Lake. As is common in the lakes in Adams County, Parker Lake has pH levels starting at just under neutral (6.42) at 35' depth and increasing in alkalinity as the depth gets less, until the surface water pH averages 8.05. A lake's pH level is important for the release of potentially harmful substances and also affects plant growth, fish reproduction and survival. Most plants grow best at pH levels between 5.5 and 8.

More importantly for many lakes, fish reproduction and survival are very sensitive to pH levels. The chart below indicates the effect of pH levels under 6.5 on fish (Figure 28):

Figure 27: Effects of pH Levels on Fish

Water pH	Effects
6.5	walleye spawning inhibited
5.8	lake trout spawning inhibited
5.5	smallmouth bass disappear
5.2	walleye & lake trout disappear
5	spawning inhibited in most fish
4.7	Northern pike, sucker, bullhead, pumpkinseed, sunfish & rock bass disappear
4.5	perch spawning inhibited
3.5	perch disappear
3	toxic to all fish

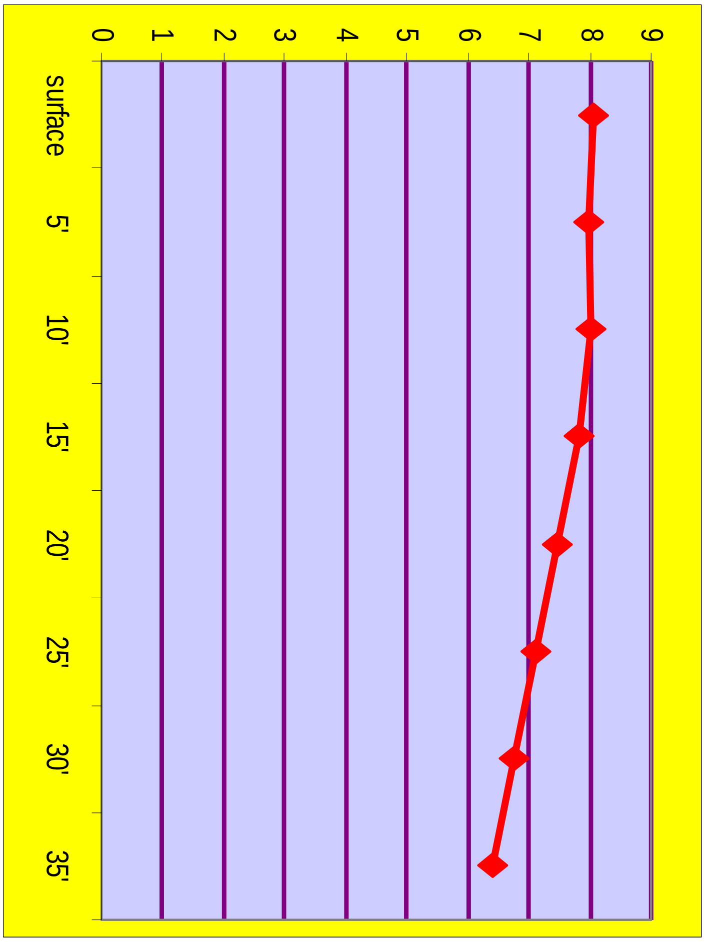


Figure 28: Parker Lake pH Averages by Depth

None of the pH readings taken scored at the pH level that inhibits walleye reproduction. A lake with a neutral or slightly alkaline pH like Parker Lake is a good lake for fish and plant survival. Natural rainfall in Wisconsin averages a pH of 5.6. This means that if the rain falls on a lake without sufficient alkalinity to buffer that acid water coming in by rainfall, the lake's fish cannot reproduce. That is not a problem at Parker Lake.

Figure 29: Most Abundant Fish in Parker Lake: Bluegill

Other Water Quality Testing Results

CALCIUM and MAGNESIUM: Calcium is required by all higher plants and some microscopic life forms. Magnesium is needed by chlorophyllic plants and by algae, fungi and bacteria. Both calcium and magnesium are important contributors to the hardness of a lake's waters. Magnesium elevated about 125 mg/l may have a laxative effect on some humans. Otherwise, no health hazards to humans and wildlife are known from these elements. The average Calcium level in Parker Lake's water during the testing period was 25.8 mg/l; this is up from the 1990s average of 14.37 mg/l, but still low. The average Magnesium level was 21.73 mg/l. Both of these are low-level readings.

CHLORIDE: Chloride does not affect plant and algae growth and is not known to be harmful to humans. It isn't common in most Wisconsin soils and rocks, so is usually found only in very low levels in Wisconsin lakes. However, the presence of a significant amount of chloride over a period of time indicates there may be negative human impacts on the water quality present from septic system failure, the presence of fertilizer and/or waste, deposition of road-salt, and other nutrients. An increased chloride level is thus a possible indication that too many nutrients are entering the lake. The chloride levels found in Parker Lake during the testing period averaged 23.5 mg/l, far above the natural level of 3 mg/l of chloride in this area of Wisconsin and higher than the 1990s average of 14.7 mg/l. These levels should be further examined to determine what contributing factors are causing the increasing chloride level.

NITROGEN: Nitrogen is necessary for plant and algae growth. A lake receives nitrogen in various forms, including nitrate, nitrite, organic, and ammonium. In Wisconsin, the amount of nitrogen in a lake's water often corresponds to the local land use. Although some nitrogen will enter a lake through rainfall from the atmosphere, that coming from land use tends to be in higher concentrations in larger amounts, coming from fertilizers, animal and human wastes, decomposing organic matter, and surface runoff. For example, the growth level of the exotic aquatic plant, Eurasian Watermilfoil (*Myriophyllum spicatum*) has been correlated with fertilization of lake sediment by nitrogen-rich spring runoff.

Nitrogen levels can affect other aspects of water quality. The sum of water testing results for nitrate, nitrite and ammonium levels of over .3 mg/l in the spring can be used to project the likelihood of an algal bloom in the summer (assuming sufficient phosphorus is also present). Parker Lake combination nitrogen level from 2004 to 2006 was .23 mg/l, just below the .3 mg/l predictive level for algal blooms. If Parker Lake can maintain such low levels, nitrogen-related algal blooms are unlikely to occur there.

SODIUM AND POTASSIUM: These elements occur naturally only in low levels in Wisconsin waters and soils. Their presence may indicate human-caused pollution. Sodium is found with chloride in many road salts and fertilizers and is also found in human and animal waste. Potassium is found in many fertilizers and also found in animal waste. Increasing levels or one or both of these elements can indicate possible contamination from damaging pollutants. High levels of sodium have also been found to influence the development of a large population of cyanobacteria, some of which can be toxic to animals and humans. The potassium level in Parker Lake is low: the average potassium reading was .7 mg/l, slightly lower than the 1990s average of .87 mg/l. The sodium level in Parker Lake surface water is elevated compared to waters in the rest of the county: 11.84 mg/l (up from the 1990s average of 8.87 mg/l). This may correlate with the elevated chloride levels, suggesting issues to be investigated.

SULFATE: In low-oxygen waters (hypoxic), sulfate can combine with hydrogen and becomes the gas hydrogen sulfate (H2S), which smells like rotten eggs and is toxic to most aquatic organisms. Sulfate levels can also affect the metal ions in the lake, especially iron and mercury, by binding them up, thus removing them from the water column. To prevent the formation of H2S, sulfate levels of 10 mg/l are best. A health advisory kicks in at 30 mg/l. Parker Lake sulfate levels averaged 6.83 mg/l during the testing period, far below either level, and lower than the 1990s level of 7.67 mg/l.

TURBIDITY: Turbidity reflects water clarity. The term refers to suspended solids in the water column—solids that may include clay, silt, sand, plankton, waste, sewage and other pollutants. Turbid water may mask the presence of bacteria or other pollutants because the water looks murky or muddy. In general, turbidity readings of less than 5 NTU are best. Very turbid waters may not only smell, but also tend to be aesthetically displeasing, thus curtailing recreational uses of the water. Turbidity levels for Parker Lake's waters were 1.96 NTU in 2004, 1.97 NTU in 2005, and 2.51 NTU in 2006—all very low levels.

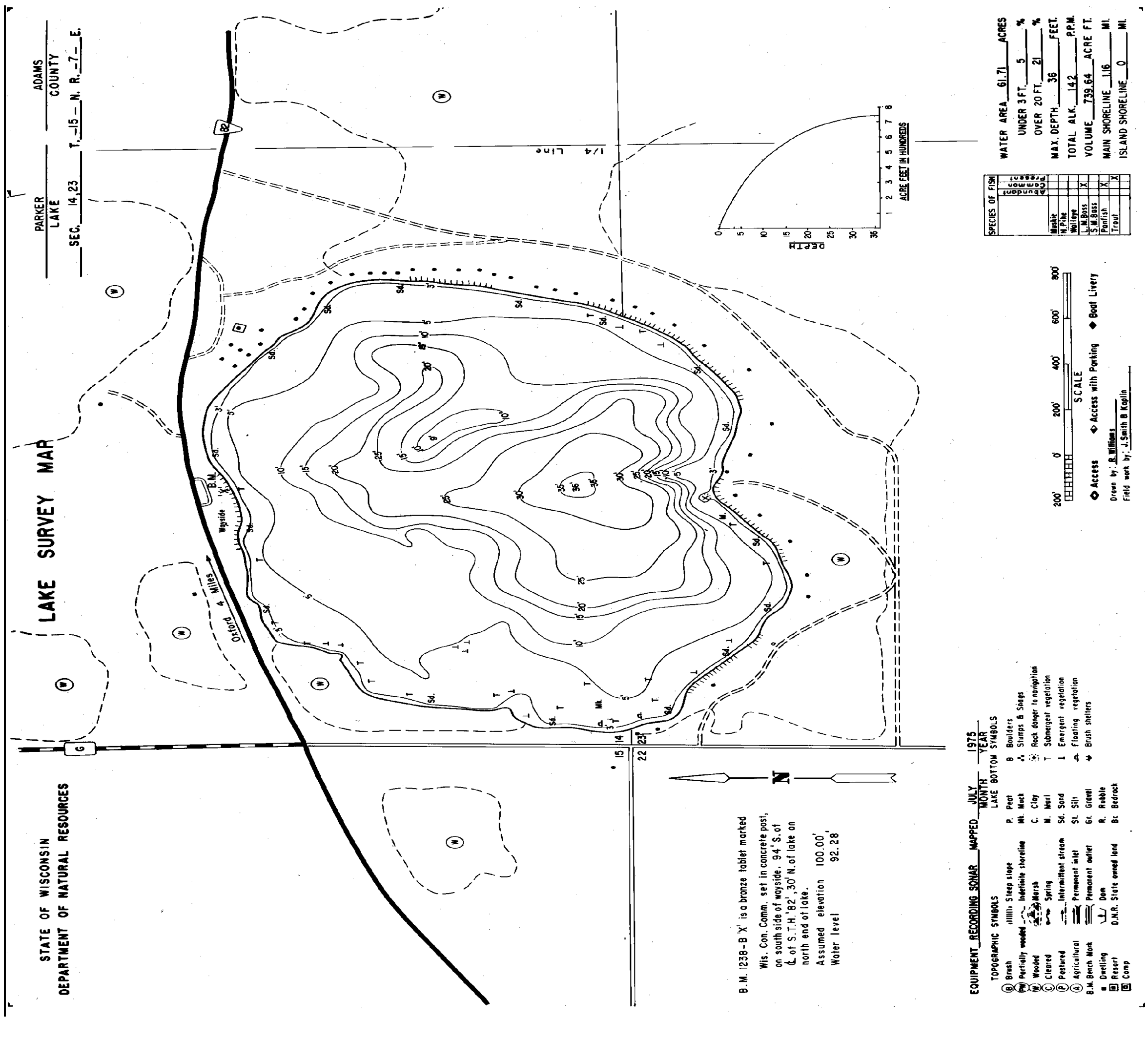
Figure 30: Glass of Very Turbid Water

Figure 31: Turbid Water in Lake

HYDROLOGIC BUDGET

Parker Lake has a surface area of 61.7 acres. According to the most recent information, the volume of the lake is 1234.2 acre-feet, and the mean depth is 20 feet. The maximum depth is 35feet.

Figure 32: Parker Lake Bathymetric Map

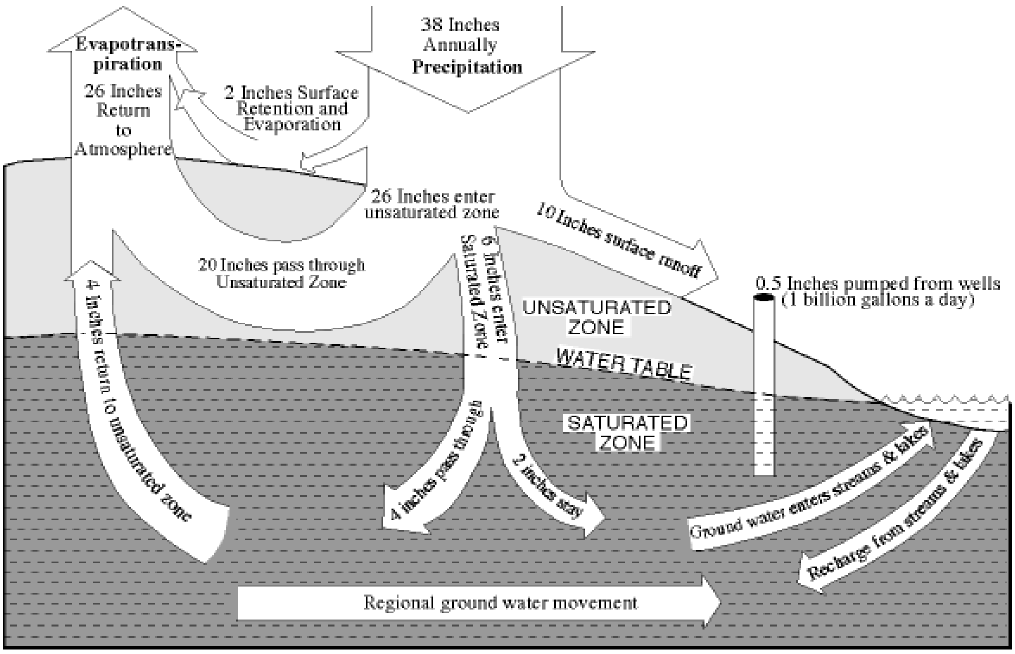


A “hydrologic budget” is an accounting of the inflow to, outflow from and storage in a hydrological unit (such as a lake). “Residence time” is the average length of time particular water stays within a lake before leaving it. This can range from several days to years, depending on the type of lake, amount of rainfall, and other factors. The “flushing rate” is the time it takes to refill the entire lake volume. The “drainage area” is the amount of area (in acres) contributing surface water runoff and nutrients to the lake. The “areal water load” is the total annual flow volume reaching the lake divided by the surface area of the lake. “Hydraulic loading” is the total annual volume of all water sources (including precipitation, non-point sources & point sources) loading into the lake.

Using the data gathered from historical testing and that done by the Adams County LWCD from 2004-2006, the WiLMS model calculated the tributary drainage area for Parker Lake as 1425.2 acres. The average unit runoff for Adams County in the Parker Lake area is 9.4 inches. WiLMS determined the expected annual runoff volume as 1116.4 acre-feet/year. Anticipated annual hydraulic loading is 1129.8 acre-feet/year. Areal water load is 18.3 feet/year.

In a seepage lake like Parker Lake, water and its nutrient load tend to stay longer within the lake before leaving it than in a lake with an inlet and/or outlet—in Parker Lake’s case, modeling estimates a water residence of 1.09 years and a flushing rate of 0.92 1/yr.

Figure 33: Example of Hydrologic Budget



TROPHIC STATE

The trophic state of a lake is one measure of water quality, basically defining the lake's biological production status (See Figure 34). **Eutrophic lakes** are very productive, with high nutrient levels, frequent algal blooms and/or abundant aquatic plant growth. **Oligotrophic lakes** are those low in nutrients with limited plant growth and small populations of fish. **Mesotrophic lakes** are those in between, i.e., those which have increased production over oligotrophic lakes, but less than eutrophic lakes; those with more biomass than oligotrophic lakes, but less than eutrophic lakes; often with a more varied fishery than either the eutrophic or oligotrophic lakes. In comparing water quality testing results with the prediction from the computer modeling of this modeling with the actual figures outlined above, the actual Trophic State of Parker Lake is what was predicted from the modeling. Modeling results predicted that the overall TSI for Parker Lake would be 45**.** This score places Parker Lake's overall TSI above the average for natural lakes in Adams County of 43.9.

Figure 34: Trophic Status Table

Score	TSI Level Description
30-40	**Oligotrophic:** clear, deep water; possible oxygen depletion in lower depths; few aquatic plants or algal blooms; low in nutrients; large game fish usual fishery
40-50	**Mesotrophic:** moderately clear water; mixed fishery, esp. panfish; moderate aquatic plant growth and occasional algal blooms; may have low oxygen levels near bottom in summer
50-60	**Mildly Eutrophic:** decreased water clarity; anoxic near bottom; may have heavy algal bloom and plant growth; high in nutrients; shallow eutrophic lakes may have winterkill of fish; rough fish common
60-70	**Eutrophic:** dominated by blue-green algae; algae scums common; prolific aquatic plant growth; high nutrient levels; rough fish common; susceptible to oxygen depletion and winter fishkill
70-80	**Hypereutrophic:** heavy algal blooms through most of summer; dense aquatic plant growth; poor water clarity; high nutrient levels

Parker Lake = 45

Phosphorus concentration, chlorophyll-a concentration and water clarity data are collected and combined to determine a trophic state. As discussed earlier, the average summer epilimnetic total phosphorus for Parker Lake was 21.61 micrograms/liter. The average summer chlorophyll-a concentration was 4.4 micrograms/liter. Growing season water clarity averaged a depth of 11.95 feet. Figure 35 shows where each of these measurements from Parker Lake fall in trophic level.

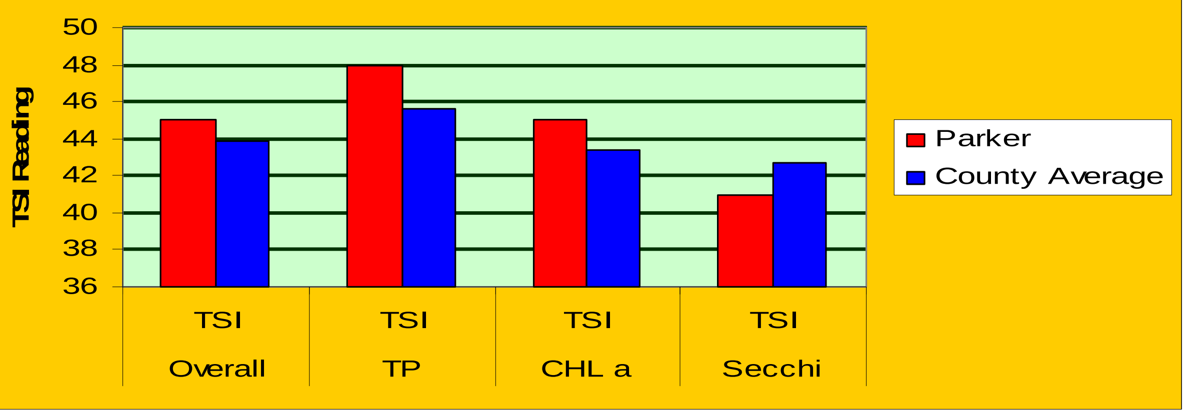
Figure 35: Parker Lake Trophic Status Overview

Trophic State	Quality Index	Phosphorus (ug/l)	Chlorophyll a (ug/l)	Sechhi Disk (ft)
Oligotrophic	Excellent	<1	<1	>19
	Very Good	1 to 10	**1 to 5**	**8 to 19**
Mesotrophic	Good	**10 to 30**	5 to 10	6 to 8
	Fair	30 to 50	10 to 15	5 to 6
Eutrophic	Poor	50 to 150	15 to 30	3 to 4
Parker Lake		**21.61**	**4.44**	**11.95**

These figures show that Parker Lake has low levels overall for the three parameters often used to describe water quality: Secchi disk depths; average TP for the growing season; and chlorophyll a levels. It is normal for all of these values to fluctuate during a growing season. However, they can be affected by human use of the lake, by summer temperature variations, by algae growth & turbidity, and by rain or wind events. According to these results, Parker Lake scores as **"**mesotrophic**"** in its phosphorus level, and "oligotrophic" in chlorophyll-a readings and Secchi disk readings. With such phosphorus readings and chlorophyll a readings, dense plant growth and frequent algal blooms would not be expected.

Parker Lake ranks slightly higher in all parameters than the average natural lake in Adams County, as shown in Figure 36. In the TSI index, this is not a positive factor; instead, the lower the number, the better.

Figure 36: Trophic State Index for Parker Lake



IN-LAKE HABITAT

Aquatic Plants

A healthy aquatic plant community plays a vital role within the lake community. This is due to the role plants play in improving water quality, providing valuable habitat resources for fish and wildlife, resisting invasions of non-native species and checking excessive growth of the most tolerant species.

An aquatic plant survey was done on Parker Lake in the summer of 2005 by staff from the Adams County LWCD. The results verified that Parker Lake is a borderline mesotrophic/oligotrophic lake with very good water quality and excellent water clarity, although nutrient level and algae frequency seem to be increasing. Filamentous algae was found at 38.9% of the sites in Parker Lake, with the greatest presence found in the 0-1.5' depth zone.

The aquatic plant community colonized approximately 100% of the littoral zone of Parker Lake, to a maximum rooting depth of 18.5 feet. The 0 to 1.5 foot depth zone supported the most abundant aquatic plant growth. The quality of the aquatic plant community in Parker Lake is about average for Wisconsin lakes and for lakes in the North Central Hardwood region, as measured by the AMCI. Structurally, it does contain emergent plants, rooted plants with floating leaves, and submergents. However, the community is characterized by plants that tolerate a high amount of disturbance and common filamentous algae.

The most frequent and dominant plant in the lake was actually a plant-like algae, *Chara* spp. Sub-dominant were *Myriophyllum spicatum, Najas guadelupensis*, and *Potamogeton illinoensis.* Nearly 94% of the sample sites had rooted aquatic plants. Four species reached a frequency of 50% or greater: *Chara* spp; *Myriophyllum spicatum* (Eurasian watermilfoil, an aggressive invasive), *Potamogeton illinoenisis* (Illinois pondweed), and *Potamogeton pectinatus.*

In Parker Lake, species found in a greater than average density were: *Ceratophyllum demersum*:; *Chara* spp. *Myriophyllum spicatum; Najas guadelupensis* (Southern naiad); *Nymphaea odorata* (white water lily); and *Potamogeton illinoensis. Potamogeton crispus* and *Phalaris arundinacea*, two of the three exotics found in Parker Lake, were not present in high frequency, high density or high dominance.

Figure 37: Parker Lake Aquatic Plant Species 2005

Scientific Name	Common Name
Emergent Plants	
Carex stricta	Tussock Sedge
Eleocharis palustris	Creeping Spikerush
Iris versicolor	Blue-Flag Iris
Phalaris arundinacea	Reed Canarygrass
Rumex spp	Water Dock
Salix spp	Willow
Scirpus validus	Soft-Stem Bulrush
Sparganium eurycarpum	Common Burreed
Typha latifolia	Narrow-Lead Cattail
Floating-Leaf Rooted Plants	
Nymphaea odorata	White Water Lily
Polygonum amphibium	Water Smartweed
Submergent Plants	
Ceratophyllum demersum	Coontail
Myriophyllum spicatum	Eurasian Watermilfoil
Najas guadelupensis	Southern Naiad
Potamogeton crispus	Curly-Leaf Pondweed
Potamogeton gramineus	Variable-Leaf Pondweed
Potamogeton illinoensis	Illinois Pondweed
Potamogeton pectinatus	Sage Pondweed
Potamogeton zosteriformis	Flat-Stem Pondweed
Vallisneria americana	Water Celery
Plant-Like Algae	
Chara spp	Muskgrass

The presence of several invasive, exotic species is a significant factor. A visual survey in late May 2006 indicated Curly-Leaf Pondweed was found in much of the lake, although not in amounts of high frequency or density. Reed Canarygrass was only found in the shallowest depth zone. However, both when the August 2005 survey was done and during the 2006 visual survey, large dense patches of Eurasian Watermilfoil (EWM) were evident all over the lake. Its tenacity and ability to spread to large areas fairly quickly make it a danger to the diversity of Parker Lake's current aquatic plant community. The Parker Lake Association controlled the EWM growth in 2007 by chemically treating the largest patches in the lake. Another treatment is planned for

2008. Continued monitoring and management of EWM is necessary to keep it from taking over Parker Lake's aquatic plant community.

The study used the results of the 2005 field survey to evaluate Parker Lake by using several standard community measurements. For example, the Simpson's Diversity Index was 0.88, indicating good species diversity. A rating of 1.0 would mean that each plant in the lake was a different species (the most diversity achievable).

A Coefficient of Conservatism and a Floristic Index calculation were performed on the field results. Technically, the average Coefficient of Conservatism measures the community's sensitivity to disturbance, while the Floristic Index measures the community's closeness to an undisturbed condition. Indirectly, they measure past and/or current disturbance to the particular community. The lower the numerical value a plant has, the more likely it is to be found in disturbed areas.

The Average Coefficient of Conservation for Parker Lake was 3.9. This puts it in the lowest quartile for Wisconsin Lakes (6.0) and for lakes in the North Central Hardwood Region (5.6). The aquatic plant community in Parker Lake is in the category of those most tolerant of disturbance, probably due to selection by a series of past disturbances.

The Floristic Quality Index of the aquatic plant community in Parker Lake of 17.87 is below average for Wisconsin Lakes (22.2) and the North Central Hardwood Region (20.9). This indicates that the plant community in Parker Lake is farther from an undisturbed condition than the average lake in Wisconsin overall and in the North Central Hardwood Region. In other words, the aquatic plant community in Parker Lake has been impacted by an above average amount of disturbance.

Another measure, the Aquatic Macrophyte Community Index (AMCI) for Parker Lake was 56. This is above average for lakes in Wisconsin and average for the North Central Hardwoods Region of the state.

Plant distribution, frequency and density varied considerably within Parker Lake, depending on the plant types (see Figure 38).

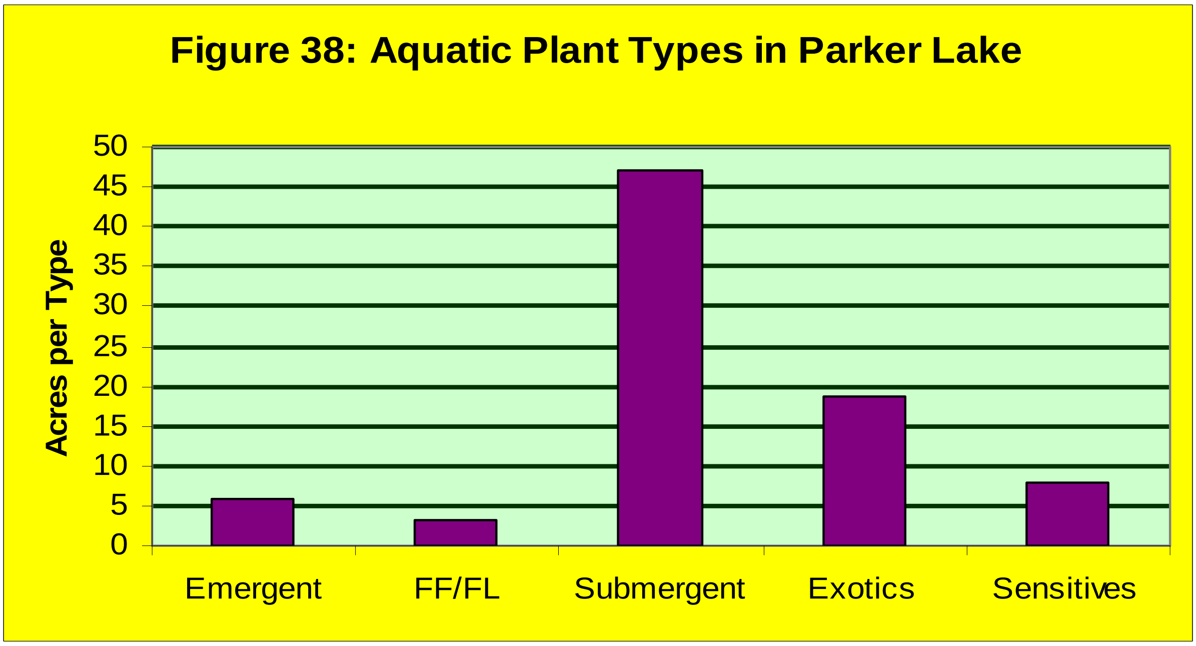


Figure 39a: Emergent Aquatic Plants in Parker Lake (2005)

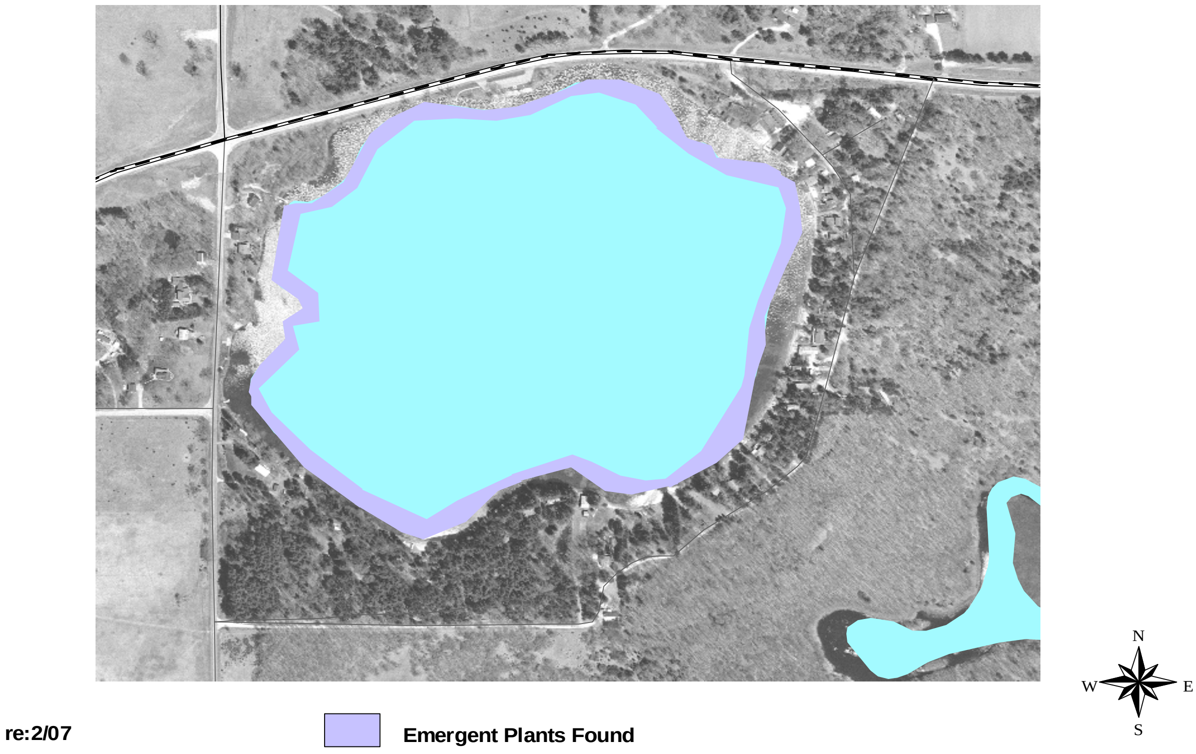


Figure 39b: Free-Floating & Floating Leaf Plants in Parker Lake

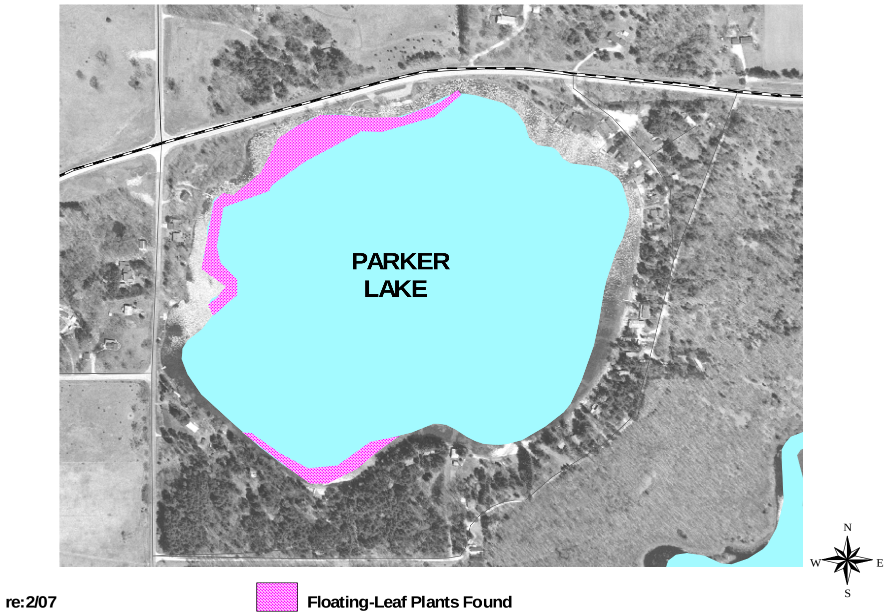
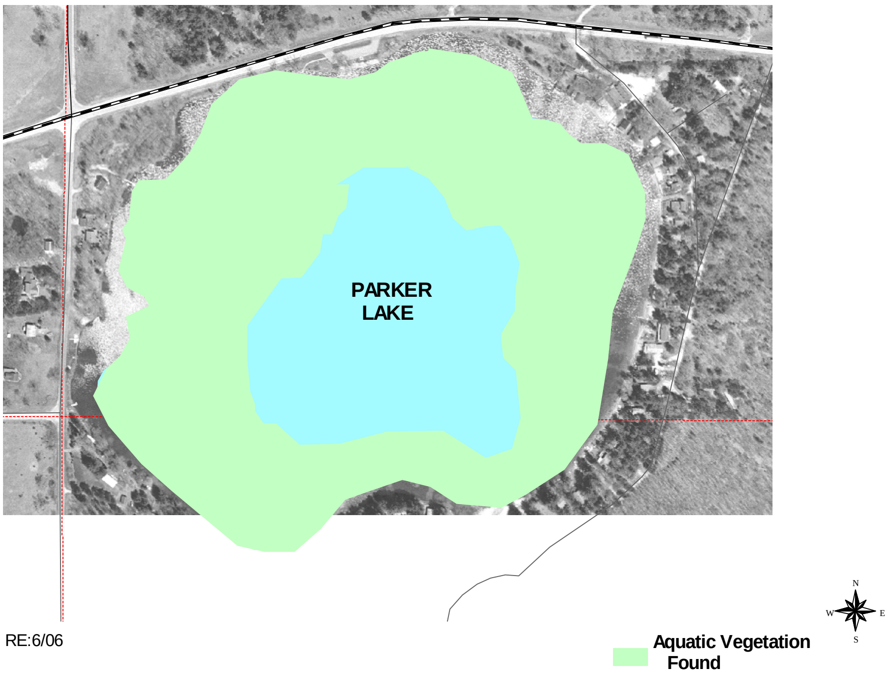
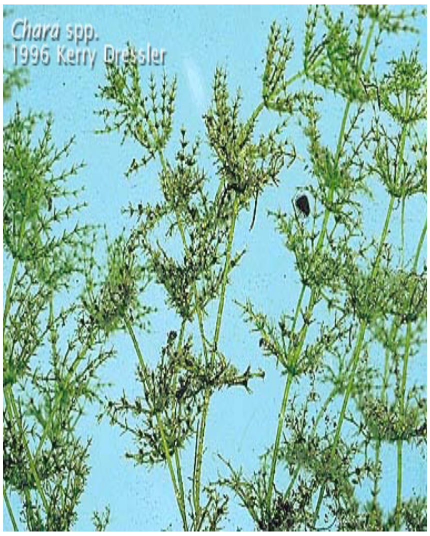


Figure 39c: Submergent Aquatic Species in Parker Lake (2005)





Chara spp   **Muskgrass**

Figure 40: Most Common Native Aquatic Species in Parker Lake

Najas guadelupensis
Southern Naid

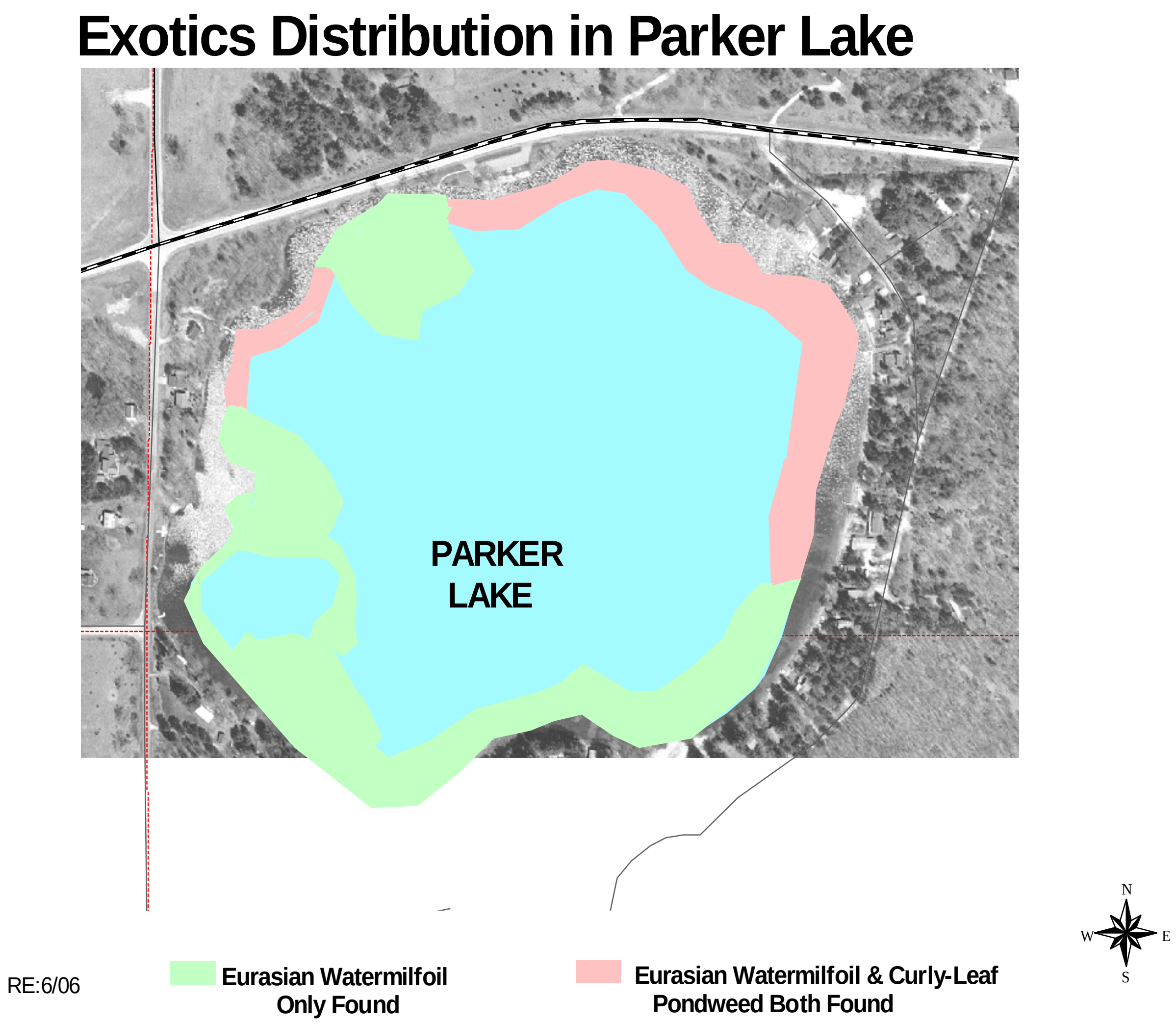
Potamogeton pectinatus
Sago Pondweed

Potamogeton illinoensis
Illinois Pondweed

Aquatic Invasives

It is unknown when Curly-Leaf Pondweed and Eurasian Watermilfoil were introduced to Parker Lake. Both were found during the aquatic plant survey in August 2005. It is possible that Curly-Leaf Pondweed, which usually dies off early in July, was underrepresented during the August 2005 survey, since that was late in the year for that plant.

Figure 41: Distribution of EWM & CLP Aquatic Plants in 2005



A third invasive found at Parker Lake was the emergent/wetland plant, *Phalaris arundinacea* (Reed Canarygrass). However, it had a frequency less than ½ of Curly-Leaf Pondweed and 1/7 of Eurasian Watermilfoil.

Figure 42: Invasives found at Parker Lake in 2005
Myriophyllum spicatum **(Eurasian Watermilfoil);** ***Potamogeton crispus*** **(Curly-Leaf Pondweed); and** ***Phalaris arundinacea*** **(Reed Canarygrass)**

Myriophyllum spicatum

Potamogeton crispus

Phalaris arundinacea

FISHERY/WILDLIFE/ENDANGERED RESOURCES

There was a chemical kill of fish in 1966 to remove carp from Parker Lake. WDNR stocking records for Parker Lake go back to 1967, when the lake was stocked with walleye, rainbow & brown trout and bluegills. Stocking of these three fish continued until 1981, when it was determined that stocking for walleye and rainbow trout weren't succeeding in establishing a population. After that time, largemouth bass and brown trout were stocked.

Fishing inventories through the years tended to show that bluegill, largemouth bass and pumpkinseed were either abundant or common (depending on the year), with yellow perch, northern pike and bullheads present or scarce.

Muskrat are also known to use Parker Lake shores for cover, reproduction and feeding. Seen during the field survey were various types of waterfowl, songbirds, and turkey. Frogs and salamanders are known, using the lake shores for shelter/cover, nesting and feeding. Turtles and snakes also use this area for cover or shelter in this area, as well as nested and fed in this area.

No endangered resources are reported to occur in the Parker Lake watersheds.

Pumpkinseed

Largemouth Bass

Figure 43: Common Fish in Parker Lake

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